# EtherNet/IP Modules in Logix5000 Control Systems

Allen-Bradley

Catalog Numbers 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, 1768-ENBT, 1769-L23E-QB1B, 1769-L23E-QBFC1B, 1769-L32E, 1769-L35E, 1783-ETAP, 1783-ETAP1F, 1783-ETAP2F, 1794-AENT, 20-COMM-E, 22-COMM-E, 1734-AENT, 1734-AENTR

User Manual

Allen-Bradley • Rockwell Software

Rockwell Automation

## Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

| | |
|---|---|
| **WARNING** | Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |
| **ATTENTION** | Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence |
| **SHOCK HAZARD** | Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present. |
| **BURN HAZARD** | Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures. |

Allen-Bradley, ArmorPOINT, CompactLogix, ControlLogix, DriveLogix, FLEX I/O, FlexLogix, Guard I/O, Logix5000, POINT I/O, Rockwell Automation, RSLinx, RSLogix 5000, Stratix 6000, Stratix 8000, and TechConnect are trademarks of Rockwell Automation, Inc.

Trademarks not belonging to Rockwell Automation are property of their respective companies.

## Introduction

This release of this document contains new and updated information. To find new and updated information, look for change bars, as shown next to this paragraph.

## Updated Information

The document contains these changes.

| Topic | Page |
|---|---|
| Description of 1783-ETAP1F and 1783-ETAP2F EtherNet/IP Fiber Taps to the EtherNet/IP Overview chapter | 13 |
| Updated Rockwell Automation Products with Embedded Switch Technology section | 58 |
| 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP Tap Status Indicators | 187 |

Additional less significant changes have been made throughout the document. Change bars mark all changes.

## Notes:

# Table of Contents


**Preface**

Purpose of This Manual . . . . . 11
Who Should Use This Publication . . . . . 11

**Chapter 1**

**EtherNet/IP Overview**

Introduction . . . . . 13
1756-ENBT Module . . . . . 15
Additional Resources . . . . . 15
1756-EN2F, 1756-EN2T, 1756-EN2TR, and 1756-EN2TXT Modules . . . . . 15
Additional Resources . . . . . 16
1768-ENBT Module . . . . . 17
Additional Resources . . . . . 17
1769-L23E-QB1B, 1769-L23E-QBFC1B Packaged Controllers . . . . 17
Additional Resources . . . . . 17
1769-L32E and 1769-L35E Controllers . . . . . 18
Additional Resources . . . . . 18
1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP Taps . . . . . 18
Additional Resources . . . . . 19
1788-ENBT Module . . . . . 19
Additional Resources . . . . . 19
1794-AENT Adapter . . . . . 20
Additional Resources . . . . . 20
1734-AENT and 1734-AENTR Adapters . . . . . 20
Additional Resources . . . . . 20
1738-AENT and 1738-AENTR Adapters . . . . . 21
Additional Resources . . . . . 21
20-COMM-E Module . . . . . 21
Additional Resources . . . . . 21
22-COMM-E Module . . . . . 22
Additional Resources . . . . . 22
EtherNet/IP Communication Modules in a Control System . . . . . 23
Installing Communication Modules or Other Devices on the EtherNet/IP Network . . . . . 24
Safety I/O in EtherNet/IP Control Systems . . . . . 24
I/O Module Overview . . . . . 24
Guard I/O Catalog Numbers . . . . . 25
CIP Safety in EtherNet/IP Safety Architectures . . . . . 26
Bridge Across Networks . . . . . 27
EtherNet/IP Network Specifications . . . . . 30

**Chapter 2**

**Configure a Workstation to Operate on an EtherNet/IP Network**

Introduction . . . . . 33
Configure the Ethernet Communication Driver in RSLinx Software . . . . . 34

## Chapter 3

**Configure Stratix Switches**

Introduction . . . . . 37
Select a Switch . . . . . 37
Set Up the Hardware . . . . . 38
Switch Features. . . . . 38
Additional Resources . . . . . 39

## Chapter 4

**Configure an EtherNet/IP Module to Operate on the Network**

Introduction . . . . . 41
Determine Network Parameters . . . . . 41
Set the IP Network Address . . . . . 43
Assign Network Parameters via the BOOTP/DHCP Utility . . . . . 45
Other Methods to Assign Network Parameters . . . . . 47
    Configure the Module with RSLinx Software . . . . . 48
    Configure Your Module with RSLogix 5000 Software . . . . . 50
    Use DHCP Software to Set the IP Address . . . . . 51
Duplicate IP Address Detection . . . . . 51
    Detection of Duplicate IP Addresses . . . . . 53
IP Address Swapping . . . . . 53
DNS Addressing . . . . . 54
Use EtherNet/IP Modules in a Logix5000 Controller Application . . . . . 55

## Chapter 5

**Configure a Supervisor on a Device-level Ring Network**

Introduction . . . . . 57
Rockwell Automation Products with Embedded Switch Technology . . . . . 58
    Features Common to Products with Embedded Switch Technology. . . . . 59
    Supervisor Node . . . . . 61
    Ring Node . . . . . 63
Construct the Physical Network . . . . . 63
Configure Supervisor Nodes on a DLR Network . . . . . 64
    Configure a Ring Supervisor in RSLogix 5000 Programming Software . . . . . 65
    Enable Ring Supervisor in RSLogix 5000 Programming Software . . . . . 68
    Configure and Enable a Ring Supervisor in RSLinx Classic Communication Software . . . . . 71
Complete the Physical Connections of the Network . . . . . 74
Verify Supervisor Configuration . . . . . 75
Troubleshoot DLR Network Issues . . . . . 75

## Chapter 6

**Control I/O**

Introduction . . . . . 77
Set Up the Hardware . . . . . 77
Add Distributed I/O . . . . . 78
Add a Module. . . . . 79
Select a Communication Format . . . . . 82
Choosing a Direct or Rack-optimized Connection . . . . . 83
Ownership . . . . . 86
Select a Remote Adapter . . . . . 87
Set the Requested Packet Interval (RPI) . . . . . 88
Access Distributed I/O . . . . . 90
Additional Resources . . . . . 92

## Chapter 7

**Interlocking and Data Transfer Between Controllers**

Introduction . . . . . 93
Set Up the Hardware . . . . . 93
Logix5000 Controller Combinations . . . . . 94
Tag Guidelines for Produced or Consumed Data . . . . . 95
Terminology . . . . . 95
Connections for Produced and Consumed Tags . . . . . 96
Produce a Tag . . . . . 98
Configure the Produced Tag . . . . . 98
Consume Data Produced by Another Controller. . . . . 100
Add the Producer Controller to the Consumer's I/O Configuration . . . . . 100
Create the Consumed Tag . . . . . 103
Guidelines for Message (MSG) Instructions. . . . . 105
Connections for Messages . . . . . 106
Cache Message Connections . . . . . 106
Enter Message Logic . . . . . 107
Add the EtherNet/IP Module to the Local Controller's I/O Configuration . . . . . 107
Enter a Message . . . . . 110
Configure a MSG Instruction . . . . . 111
Communicate with PLC-5 or SLC Processors . . . . . 115
Converting between INTs and DINTs . . . . . 115
Mapping Tags. . . . . 116
Receive MSGs from PLC-5 or SLC 500 Processors . . . . . 118

## Chapter 8

**Send Email**

Introduction . . . . . 119
EtherNet/IP Module as an Email Client . . . . . 119
Send Email Via a Controller-initiated Message Instruction . . . . . 121
Create String Tags . . . . . 121
Enter the Ladder Logic . . . . . 125
Configure the MSG Instruction That Identifies the Mail Relay Server . . . . . 125
Configure the MSG Instruction That Contains the Email Text . . . . . 127
Enter Email Text . . . . . 129
Possible Email Status Codes . . . . . 129

## Chapter 9

**Communicate with PanelView Terminals**

Introduction . . . . . 131
Set Up the Hardware . . . . . 131
Logix5000 Controller Combinations . . . . . 132
Connections to PanelView Terminals . . . . . 132
Add a PanelView Terminal . . . . . 133
Organize Controller Data for a PanelView Terminal . . . . . 136
Connections to RSView Applications . . . . . 136

## Chapter 10

**Monitor Diagnostics**

Introduction . . . . . 137
Diagnostic Web Pages . . . . . 138
Network Settings . . . . . 141
Explicit Message Connections . . . . . 142
I/O Connections . . . . . 143
Ethernet Statistics . . . . . 144

## Chapter 11

**Troubleshoot an EtherNet/IP Module**

Introduction . . . . . 147
Access Web Browser Support . . . . . 147
Diagnostic Overview Statistics . . . . . 149
Message Connections . . . . . 152
I/O Connections . . . . . 153
Ethernet Statistics . . . . . 153
Switch Considerations . . . . . 157
Internet Group Multicast Protocol . . . . . 157
Virtual Local Area Networks . . . . . 158
Port Mirroring . . . . . 159

**Chapter 12**

**USB Serial Communication**

Introduction . . . . . 161
Set Up the Hardware . . . . . 161
Configure a Module Via the USB Port . . . . . 162
Set Up a USB Driver . . . . . 163
Flash Upgrade Firmware through a USB Port . . . . . 165

**Appendix A**

**Status Indicators**

Introduction . . . . . 167
1756-ENBT EtherNet/IP Module Status Indicators. . . . . 169
1756-EN2F EtherNet/IP Module Status Indicators . . . . . 171
1756-EN2T EtherNet/IP Module Status Indicators . . . . . 173
1756-EN2TR EtherNet/IP Module Status Indicators. . . . . 175
1756-EN2TXT ControlLogix-XT EtherNet/IP Bridge Module Status Indicators . . . . . 177
1769-L23E-QB1B and 1769-L23E-QBFC1B Controllers Status Indicators . . . . . 178
I/O Status Indicators. . . . . 182
1769-L32E and 1769-L35E Controllers Status Indicators . . . . . 183
1768-ENBT Module Status Indicators . . . . . 185
1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP Tap Status Indicators . . . . . 187
1788-ENBT EtherNet/IP Daughtercard Status Indicators. . . . . 189
1734-AENT and 1734-AENTR EtherNet/IP POINT I/O Adapter Status Indicators . . . . . 192
1738-AENTR ArmorPOINT I/O 2-port EtherNet/IP Adapter Status Indicators. . . . . 195
1794-AENT EtherNet/IP FLEX I/O Adapter Status Indicators . . . . . 199
20-COMM-E Module Status Indicators . . . . . 201
22-COMM-E Module Status Indicators . . . . . 205

**Appendix B**

**Fiber Cable and LC Connector**

Introduction . . . . . 209
Specifications . . . . . 209

**Appendix C**

**EtherNet/IP Network Connections**

Introduction . . . . . 213
CIP Connections . . . . . 213
TCP Connections . . . . . 214
Multicast Address Limit . . . . . 215
Requested Packet Interval (RPI) . . . . . 215

## Appendix D

## EtherNet/IP Network Overview

Introduction . . . . . 217
Ethernet Protocols . . . . . 217
Use of the Common Industrial Protocol (CIP) . . . . . 218
Configuration Requirements . . . . . 219
IP Address . . . . . 219
Gateways . . . . . 220
Subnet Mask . . . . . 221
Manual Configuration on an Ethernet Switch . . . . . 222
Change Ports on an Ethernet Switch . . . . . 222
Additional Resources . . . . . 222

## Index

## Purpose of This Manual

This manual describes how you can use EtherNet/IP modules with your Logix5000 controller and communicate with various devices on the Ethernet network.

## Who Should Use This Publication

You should use this manual if you program applications that use Ethernet with one of these Logix5000 controllers:

- CompactLogix controller
- ControlLogix controller
- FlexLogix controller

You should also understand:

- networking concepts.
- RSLogix 5000 programming software.
- RSLinx Classic programming software.

## Notes:

# EtherNet/IP Overview

## Introduction

The Logix5000 family of controllers offers several EtherNet/IP communication modules.


| Topic | Page |
|---|---|
| 1756-ENBT Module | 15 |
| 1756-EN2F, 1756-EN2T, 1756-EN2TR, and 1756-EN2TXT Modules | 15 |
| 1768-ENBT Module | 17 |
| 1769-L23E-QB1B, 1769-L23E-QBFC1B Packaged Controllers | 17 |
| 1769-L32E and 1769-L35E Controllers | 18 |
| 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP Taps | 18 |
| 1788-ENBT Module | 19 |
| 1794-AENT Adapter | 20 |
| 1734-AENT and 1734-AENTR Adapters | 20 |
| 1738-AENT and 1738-AENTR Adapters | 21 |
| 20-COMM-E Module | 21 |
| 22-COMM-E Module | 22 |
| EtherNet/IP Communication Modules in a Control System | 23 |
| Safety I/O in EtherNet/IP Control Systems | 24 |
| Bridge Across Networks | 27 |
| EtherNet/IP Network Specifications | 30 |

Select a module based on the EtherNet/IP functions the application requires.

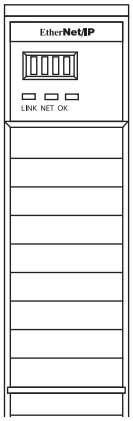
**EtherNet/IP Module Functions and Applications**

| Module | Works With a Controller to Originate Communication (Scanner/Bridge) | Interfaces With Distributed I/O Modules (Adapter) or End Node |
|---|---|---|
| 1734-AENT | | X |
| 1738-AENT, 1734-AENTR | | X |
| 1756-ENBT | X | X |
| 1756-EN2F | X | X |
| 1756-EN2T, 1756-EN2TR, 1756-EN2TXT | X | X |
| 1768-ENBT | X | |
| 1769-L23E-QB1B, 1769-L23E-QBFC1B | X | |
| 1769-L32E, 1769-L35E | X | |
| 1788-ENBT | X | |
| 1794-AENT | | X |
| 2*x*-COMM-E | | X |

The EtherNet/IP communication modules:

- support messaging, produced/consumed tags, and distributed I/O.
- encapsulate messages within standard TCP/UDP/IP protocol.
- share a common application layer with ControlNet and DeviceNet network protocols.
- interface via RJ45, category 5, unshielded, twisted-pair cable, except for the 1756-EN2F fiber cable, which has a fiber connector.
- support half/full duplex 10 Mbps or 100 Mbps operation.
- require no network scheduling.
- require no routing tables.

## 1756-ENBT Module




The 1756-ENBT module operates either as an interface for a ControlLogix controller to communicate with other devices over an EtherNet/IP network or as an adapter for 1756 I/O modules on an EtherNet/IP network. This module supports:

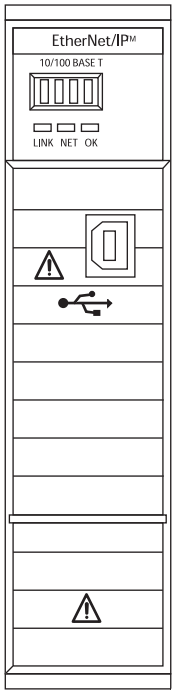
- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- an adapter for 1756 I/O modules.
- a web server to provide diagnostic and status information.

### Additional Resources

| Resource | Description |
|---|---|
| 1756-ENBT ControlLogix EtherNet/IP Bridge Module Installation Instructions, publication 1756-IN019 | Details how to install the module and provides technical specifications. |
| 1756-ENBT ControlLogix Redundancy System Revision 15 User Manual, publication 1756-UM523 | Details how to use and maintain a ControlLogix redundancy system. |

## 1756-EN2F, 1756-EN2T, 1756-EN2TR, and 1756-EN2TXT Modules

1756-EN2T




The following modules perform the same functions as the 1756-ENBT module but with twice the capacity for demanding applications.

- 1756-EN2F ControlLogix EtherNet/IP fiber module
- 1756-EN2T ControlLogix EtherNet/IP bridge module
- 1756-EN2TR ControlLogix EtherNet/IP 2-port module
- 1756-EN2TXT ControlLogix-XT EtherNet/IP module

All modules support:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- an adapter for 1756 I/O modules.
- USB serial communication, enabling a laptop or workstation to access and program a Logix5000 controller. For more information, see the chapter USB Port Connection.
- a web server to provide diagnostic and status information.
- rotary switches for quick IP address configuration.

The **1756-EN2F module only** supports an LC fiber connector to support additional applications. For more information on LC fiber connectors, see Fiber Cable and LC Connector on page 209.

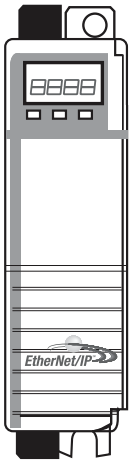
The **1756-EN2TR module only** supports connection of a ControlLogix system to a linear or device level ring (DLR) network.

The **1756-EN2TXT module only** supports use of the module in extreme temperatures. The module is capable of operating in temperatures from -25..70° C (-13..158° F).

## Additional Resources

| Resource | Description |
|---|---|
| 1756-EN2T ControlLogix EtherNet/IP Bridge Module Installation Instructions, publication 1756-IN603 | Details how to install the module and provides technical specifications. |
| 1756-EN2TR ControlLogix EtherNet/IP 2-port Module Installation Instructions , publication 1756-IN612 | Details how to install the module and provides technical specifications. |
| 1756-EN2F ControlLogix EtherNet/IP Fiber Module Installation Instructions, publication 1756-IN606 | Details how to install the fiber module and provides technical specifications. |
| 1756-EN2TXT ControlLogix-XT EtherNet/IP Bridge Module Installation Instructions, publication 1756-IN635 | Details how to install the fiber module and provides technical specifications. |

## 1768-ENBT Module




The 1768-ENBT module is an interface that enables a 1768-L43 or 1768-L45 CompactLogix controller to communicate with devices over an EtherNet/IP network. The module supports:

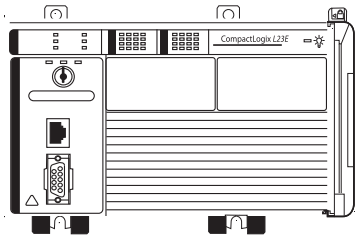
- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- a web server to provide diagnostic and status information.

### Additional Resources

| Resource | Description |
|---|---|
| 1768-ENBT CompactLogix EtherNet/IP Communication Module Installation Instructions, publication 1768-IN002 | Details how to install the module and provides technical specifications. |
| 1768 CompactLogix Controllers User Manual, publication 1768-UM001 | Details how to program and maintain the controller. |

## 1769-L23E-QB1B, 1769-L23E-QBFC1B Packaged Controllers

1769-L23E-QB1B



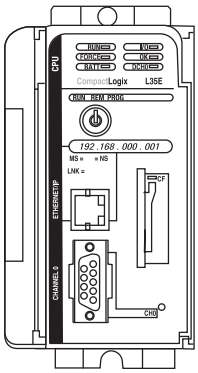

The 1769-L23E-QB1B and 1769-L23E-QBFC1B CompactLogix packaged controllers have an integrated EtherNet/IP port. Through this port, the controller supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- a web server to provide diagnostic and status information.

### Additional Resources

| Resource | Description |
|---|---|
| 1769-L23E-QB1B, 1769-L23E-QBFC1B CompactLogix Packaged Controller Installation Instructions, publication 1769-IN082 | Details how to install the controller and provides technical specifications. |
| 1769-L23E-QB1B, 1769-L23E-QBFC1B CompactLogix Packaged Controller Quick Start and User Manual, publication IASIMP-QS010 | Details how to program and maintain controllers. |

## 1769-L32E and 1769-L35E Controllers



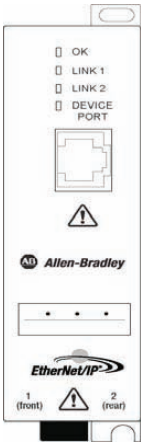

The 1769-L32E and 1769-L35E CompactLogix controllers have an integrated EtherNet/IP port. Through this port, the controller supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- a web server to provide diagnostic and status information.

### Additional Resources

| Resource | Description |
|---|---|
| 1769-L32E and 1769-L35E CompactLogix Controller Installation Instructions, publication 1769-IN020 | Details how to install the controller and provides technical specifications. |
| 1769-L32E and 1769-L35E CompactLogix System User Manual, publication 1769-UM011 | Details how to program and maintain controllers. |

## 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP Taps




1783-ETAP, 1783-ETAP1F and 1783-ETAP2F taps allow devices that do not support embedded switch technology to connect to linear and DLR networks. Each tap supports:

- a device port on the front of the tap to connect to other devices.
- two network ports to connect the tap to linear and DLR networks.
- the functionality to divide an Ethernet network into segments and direct network traffic more efficiently than using repeating hubs.
- the functionality to connect one of the tap ports to a single device segments the network so you can dedicate bandwidth to that device.
- multiple simultaneous communication between devices on different ports.

The network ports used to connect to linear or DLR networks are different for each tap. The following table describes the types of taps used with each tap:

| Cat. No. | Network Ports | Description |
|---|---|---|
| 1783-ETAP | 2 copper | Two copper network ports connect the tap to copper linear or DLR networks. |
| 1783-ETAP1F | 1 copper<br>1 fiber | One copper network port connects the tap to a copper linear or DLR network, and one fiber-optic network port connects the tap to a fiber-optic linear or DLR network.<br><br>This tap is commonly used to connect a copper section with a fiber-optic section of the same network. |
| 1783-ETAP2F | 2 fiber | Two fiber-optic network ports connect the tap to a fiber-optic linear or DLR network. |

### Additional Resources

| Resource | Description |
|---|---|
| Three-Port EtherNet Tap Installation Instructions, publication 1783-IN007 | Details how to install the tap and provides technical specifications. |
| EtherNet/IP Fiber Tap Installation Instructions, publication 1783-IN008 | Details how to install the tap and provides technical specifications. |
| EtherNet/IP Ring Topology Application Manual, publication ENET-AP005 | Details how to use the tap in a ring topology. |

## 1788-ENBT Module

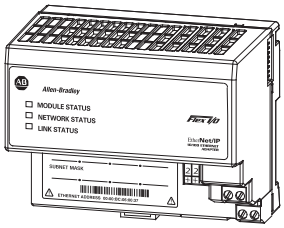
The 1788-ENBT module operates as an interface for a FlexLogix and DriveLogix controller to communicate with other devices over an EtherNet/IP network. This module supports:

- control of I/O.
- communication via produced/consumed tags and MSG instructions.
- communication with HMI.
- configuration and programming, such as uploading and downloading.
- a web server to provide diagnostic and status information.

### Additional Resources

| Resource | Description |
|---|---|
| 1788-ENBT EtherNet/IP Daughtercard Installation Instructions, publication 1788-IN054 | Details how to install the daughtercard and provides technical specifications. |

## 1794-AENT Adapter



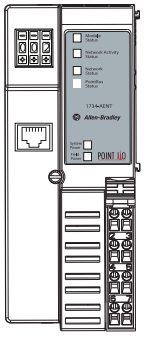

The 1794-AENT adapter operates as an adapter for FLEX I/O modules on an EtherNet/IP network. This module supports:

- control of I/O.
- module configuration.
- a web server to provide diagnostic and status information.

### Additional Resources

| Resource | Description |
|---|---|
| 1794-AENT FLEX I/O EtherNet/IP Adapter Module Installation Instructions, publication 1794-IN082 | Details how to install the adapter and provides technical specifications. |

## 1734-AENT and 1734-AENTR Adapters



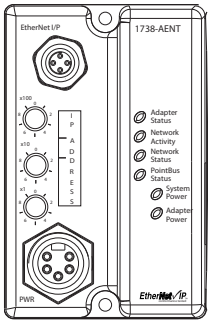

The 1734-AENT and 1794-AENTR adapters operate as adapters for POINT I/O modules on an EtherNet/IP network. These adapters support:

- control of I/O.
- module configuration.
- linear and device level ring (DLR) topologies on the 1734-AENTR adapter only.

### Additional Resources

| Resource | Description |
|---|---|
| 1734-AENT POINT I/O Ethernet Adapter Installation Instructions, publication 1734-IN590 | Details how to install the adapter and provides technical specifications. |
| 1734-AENT POINT I/O Ethernet Adapter User Manual, publication 1734-UM011 | Details how to configure and maintain an installed adapter. |

## 1738-AENT and 1738-AENTR Adapters



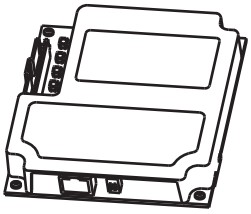

The 1738-AENT and 1738-AENTR adapters operate as adapters for ArmorPOINT I/O modules on an EtherNet/IP network. These adapters support:

- control of I/O.
- module configuration.
- linear and device level ring (DLR) topologies on the 1738-AENTR adapter only.

### Additional Resources

| Resource | Description |
|---|---|
| ArmorPOINT 2-Port EtherNet/IP Adapter Installation Instructions, publication 1738-IN028 | Details how to install the adapters and provide technical specifications. |
| POINT I/O 2-Port Ethernet Adapter User Manual, publication 1734-UM014 | Details how to configure and maintain an installed adapter. |

## 20-COMM-E Module



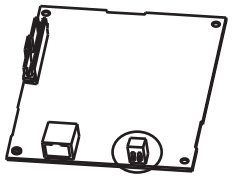
The 20-COMM-E module operates as an adapter and provides an internal EtherNet/IP connection for PowerFlex 70, 700, 700S and 700H drives, and other DPI-based host devices. This module supports:

- configuration.
- collection of data.
- peer-to-peer capability.
- a web server to provide diagnostic and status information.

### Additional Resources

| Resource | Description |
|---|---|
| 20-COMM-E PowerFlex EtherNet/IP Adapter User Manual, publication 20COMM-UM010 | Details how to program and maintain the adapter. |

## 22-COMM-E Module



The 22-COMM-E module operates as an adapter and provides an internal EtherNet/IP connection for PowerFlex 40 AC drives. This module supports:

- user configuration of a module via a process display window.
- e-mail notification of faults.
- monitoring of a diagnostics and event queue.
- direct launching of Drive Explorer or Drive Executive on a workstation to connect online over Ethernet.
- multi-drive support of up to five PowerFlex 4 and 40 AC drives to connect to a single node on an EtherNet/IP network, ultimately reducing hardware costs.

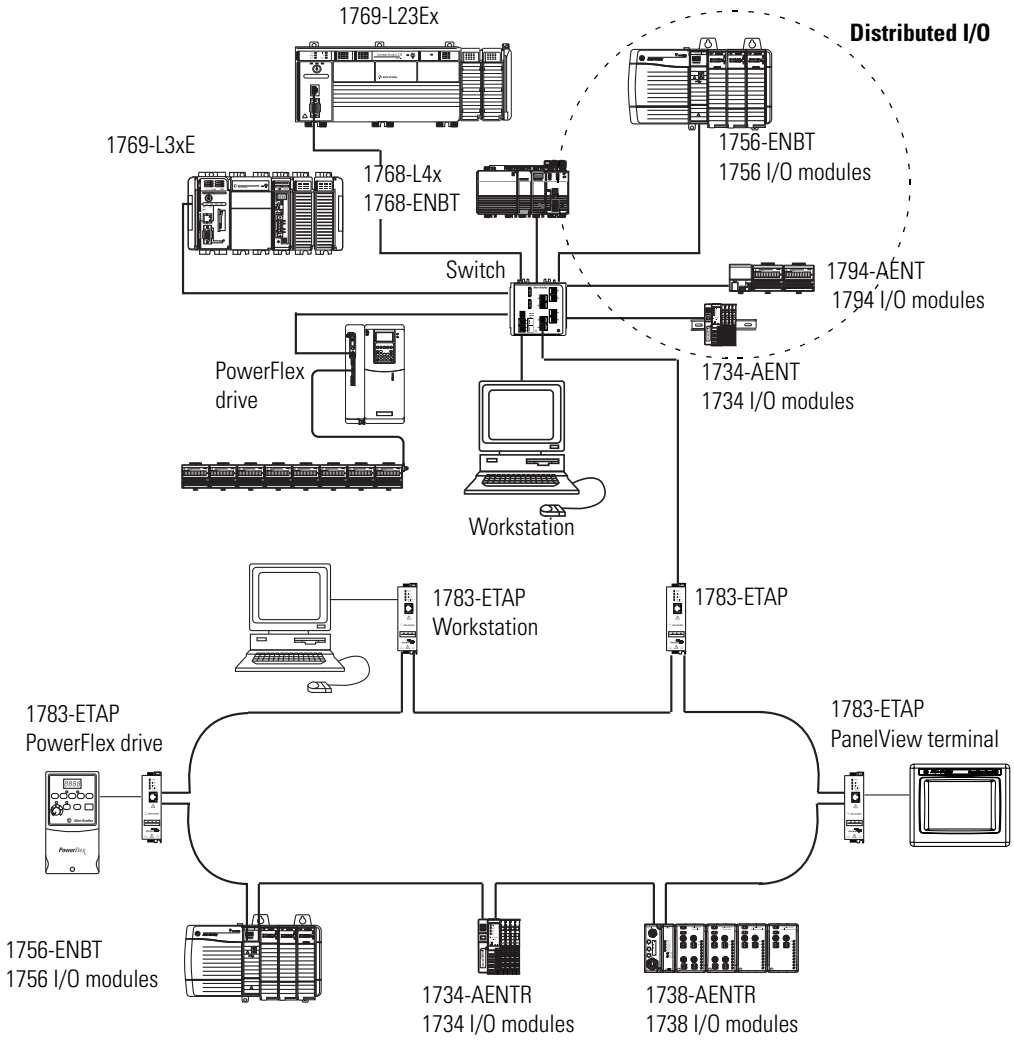
### Additional Resources

| Resource | Description |
|---|---|
| 22-COMM-E PowerFlex EtherNet/IP Adapter User Manual, publication 22COMM-UM004 | Details how to program and maintain the adapter. |

## EtherNet/IP Communication Modules in a Control System

These diagrams show how EtherNet/IP modules can fit into a control system.

**EtherNet/IP Network Overview**




In this example:

- the controllers can produce and consume tags with each other.
- the controllers can initiate MSG instructions that send/receive data or configure devices.
- the workstation can upload/download projects to the controllers.
- the workstation can configure devices on the EtherNet/IP network.

These diagrams show how EtherNet/IP modules can fit into a control system.

**IMPORTANT** For more information on how some EtherNet/IP modules and tapscan be used in a linear or DLR network, see Configure a Supervisor on a Device-level Ring Network on page 57.

### Installing Communication Modules or Other Devices on the EtherNet/IP Network

In addition to using the installation instructions for each Rockwell Automation EtherNet/IP device you install in your control system, you should also consult the EtherNet/IP Media Planning and Installation Manual available from ODVA, the organization that supports network technologies built on the Common Industrial Protocol (CIP).

You can obtain EtherNet/IP Media Planning and Installation Manual at the ODVA website, that is, http://www.odva.org.

## Safety I/O in EtherNet/IP Control Systems

Rockwell Automation offers the Guard I/O product line that implements the EtherNet/IP safety protocol. This section provides an overview of the modules use in a safety system.

For more information on using Guard I/O modules, see Guard I/O EtherNet/IP Safety Modules user manual, publication 1791ES-UM001.

### I/O Module Overview

The Guard I/O modules implement the CIP-safety protocol extensions over EtherNet/IP networks and provide various features for a safety system.

Use the modules to construct a safety-control network system that meets the requirements up to Safety Integrity Level 3 (SIL 3) as defined in IEC 61508, Functional Safety of Electrical, Electronic, and Programmable Electronic Safety-related Systems, and the requirements for Safety Category 4 of the EN 954-1 standard, Safety of machinery - Safety related parts of control systems.

Remote I/O communication for safety I/O data are performed through safety connections supporting CIP safety over an EtherNet/IP network, and data processing is performed in the safety controller.

The status and fault diagnostics of the I/O modules are monitored by a safety controller through a safety connection using a new or existing EtherNet/IP network.

The following is a list of features common to Guard I/O modules:

- CIP-safety and EtherNet/IP protocol conformance
- Safety inputs
  - Safety devices, such as emergency stop push buttons, gate switches, and safety light curtains, can be connected.
  - Dual-channel mode evaluates consistency between two input signals (channels), which allows use of the module for Safety Category 3 and 4.
  - The time of a logical discrepancy between two channels can be monitored using a discrepancy time setting.
  - An external wiring short-circuit check is possible when inputs are wired in combination with test outputs.
  - Independently adjustable on and off delay is available per channel.
- Test outputs
  - Separate test outputs are provided for short circuit detection of a safety input (or inputs).
  - Power (24V) can be supplied to devices, such as safety sensors.
  - Test outputs can be configured as standard outputs.
  - All Guard I/O modules have numerous test outputs, of which some can be used for broken wire detection of a muting lamp.
- Safety outputs
  - Dual-channel mode evaluates consistency between two output signals (channels).
  - Safety outputs can be pulse tested to detect field wiring shorts to 24V DC and 0V DC.
- I/O status data - In addition to I/O data, the module includes status data for monitoring I/O circuits.
- Removable I/O connectors - I/O connectors support mechanical keying.

## Guard I/O Catalog Numbers

See the table for a listing of the types of Guard I/O modules.

**Types of Guard I/O Modules**

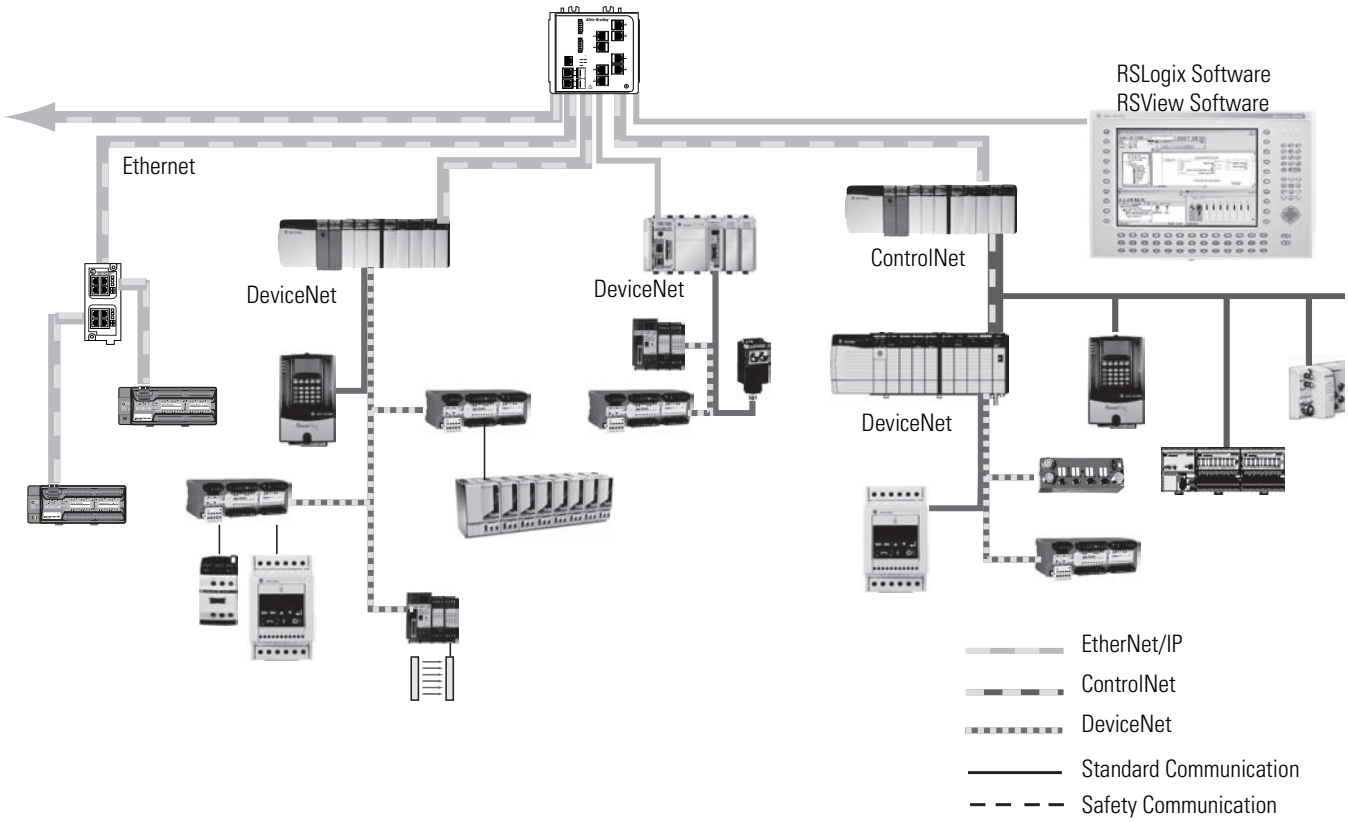
| Catalog Number | Description | Enclosure Type Rating | Safety Inputs | Test Outputs[1] | Safety Outputs |
|---|---|---|---|---|---|
| | | | | | Solid State |
| 1791ES-IB16 | Safety input module | Meets IP20 | 16 | 16 | - |
| 1791ES-IB8XOBV4 | Safety I/O module with solid state outputs | | 8 | 8 | 4 bipolar pairs |

(1) Broken wires can be detected on the muting outputs.

## CIP Safety in EtherNet/IP Safety Architectures

Use Guard I/O modules in EtherNet/IP safety architectures as shown in the figure. The Guard I/O family is a set of I/O modules that when connected to an EtherNet/IP safety network are suitable for applications up to SIL3, as defined in the IEC 61508 standard, and Safety Category 4, as defined in the EN 954-1 standard.

**Safety Interlocking and Control via CIP Safety**




Safety controllers control the safety outputs. Safety or standard controllers can control the standard outputs.

For more information on using Guard I/O modules, see Guard I/O EtherNet/IP Safety Modules user manual, publication 1791ES-UM001.

## Bridge Across Networks

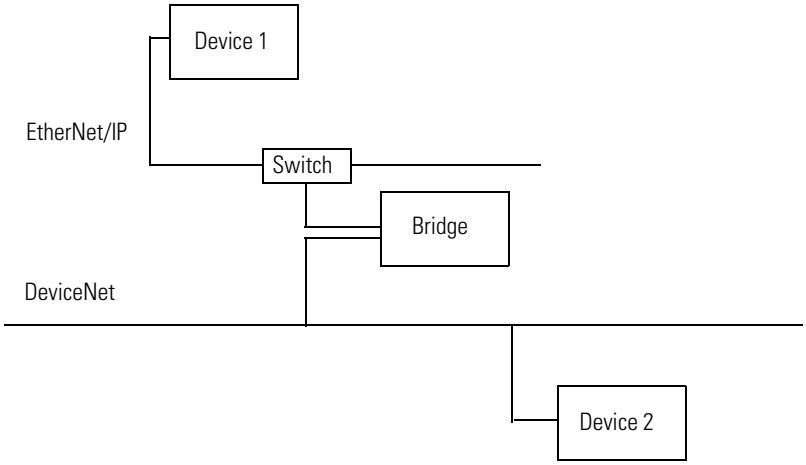
Some EtherNet/IP modules support the ability to bridge or route communication through devices, depending on the capabilities of the platform and communication devices.

**IMPORTANT** The update time of local I/O modules may increase when bridging messages.

EtherNet/IP modules do not support the transfer of data to and from I/O modules across two or more segments of any network.

You have a bridge when you have a connection between communication devices on two networks. For example, this bridge device has both EtherNet/IP and DeviceNet connections, enabling Device 1 on the EtherNet/IP network to communicate with Device 2 on a DeviceNet network through the bridge.

**Bridge Device**

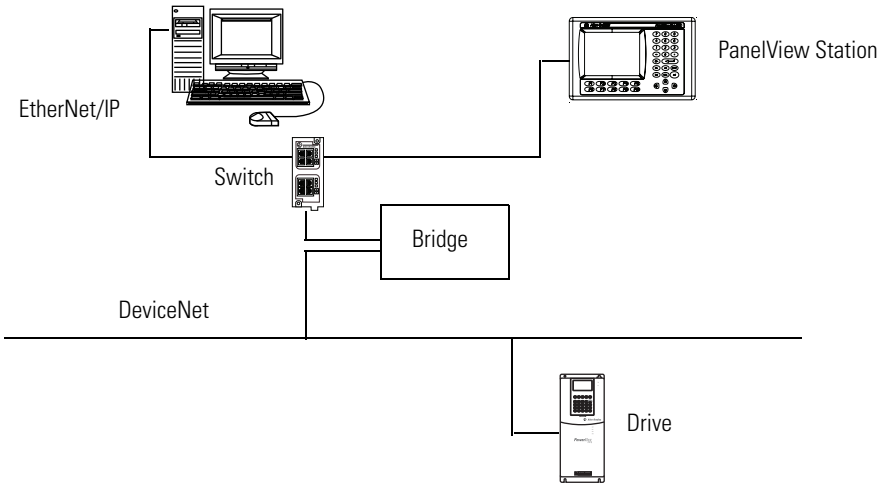



**CIP Message Bridging**

| CIP messages that originateon this network | Can bridge to this network | | | |
|---|---|---|---|---|
| | EtherNet/IP | ControlNet | DeviceNet | RS-232 Serial |
| EtherNet/IP | Yes | Yes | Yes | Yes |
| ControlNet | Yes | Yes | Yes | Yes |
| RS-232 | Yes | Yes | Yes | Yes |

Here, a workstation configures a drive on a DeviceNet network and bridges EtherNet/IP networks to reach the drive.

**Drive Configuration and Programming**




The bridge can be an EtherNet/IP-to-DeviceNet bridging device or a Logix5000 system with an EtherNet/IP communication module and a DeviceNet communication module.

The bridge can be a:

- ControlLogix chassis with a 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, and 1756-DNB module.

  The controller is not required.

- 1769-L23E-QB1B, 1756-L23E-QBFC1B, 1769-L32E, 1769-L35E CompactLogix controller with 1769-SDN module.

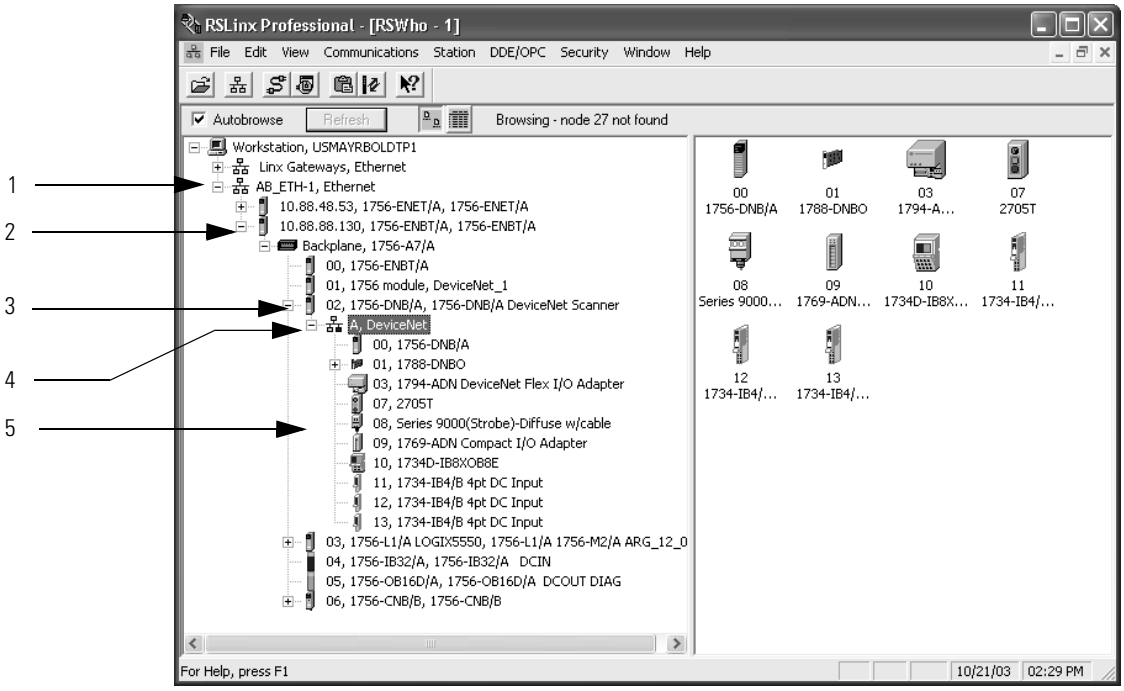
- 1768-L43 or 1768-L45 CompactLogix controller with 1768-ENBT and 1769-SDN modules.

- 1788-EN2DN linking device.

Status data can also be transferred from a DeviceNet network through the Logix5000 controller to a RSView32 operator interface. For a CompactLogix or FlexLogix controller, map the data into the DeviceNet I/O image and then use RSLinx OPC software from the workstation to the Logix5000 controller over the EtherNet/IP network. This avoids using the limited bridging resources of the CompactLogix or FlexLogix controller.

You cannot bridge EtherNet/IP I/O across networks. I/O modules must be configured in either a local chassis or a remote chassis. You cannot go through a gateway chassis to control I/O even though, in some circumstances, RSLogix 5000 programming software accepts such a configuration in the I/O Configuration folder.

### DeviceNet Bridge Linking to an EtherNet/IP Network




| Item | Description |
|---|---|
| 1 | EtherNet/IP network |
| 2 | EtherNet/IP bridge in ControlLogix system |
| 3 | DeviceNet bridge in same ControlLogix system |
| 4 | DeviceNet network |
| 5 | Distributed DeviceNet devices |

# EtherNet/IP Network Specifications

These are the EtherNet/IP network connection specifications.

**EtherNet/IP Network Specifications**

| Catalog Number | Connections | | CIP Unconnected Messages (backplane + Ethernet) | Packet Rates (packets/second)[1] | | SNMP Support (password required) | Media Support | |
|---|---|---|---|---|---|---|---|---|
| | TCP | CIP | | I/O | HMI/MSG | | Twisted Pair | Fiber |
| 1734-AENT, 1734-AENTR | 32 | 20 | 32 | 5000 | 900 | No | Yes | No |
| 1738-AENT, 1738-AENTR | 32 | 20 | 32 | 5000 | 900 | No | Yes | No |
| 1756-ENBT | 64 | 128[2] | 64 + 64 | 5000 | 900 | Yes | Yes | No |
| 1756-EN2F | 128 | 256[2] | 128 + 128 | 10,000 | 3200 | Yes | No | Yes |
| 1756-EN2T, 1756-ENT2TR, 1756-EN2TXT | 128 | 256[2] | 128 + 128 | 10,000 | 3200 | Yes | Yes | No |
| 1756-EWEB | 64 | 128[2] | 128 + 128 | N/A | 900 | Yes | Yes | No |
| 1768-ENBT[3] | 32<br>64 | 64[2]<br>128 | 32 + 32 | 5000 | 960 | Yes | Yes | No |
| 1768-EWEB | 64 | 128[2] | 128 + 128 | N/A | 960 | Yes | Yes | No |
| 1769-L23E*x* | 8 | 32[2] | 32 + 32 | 2000 | 380 | Yes | Yes | No |
| 1769-L3*x*E | 64 | 32[2] | 32 + 32 | 4000 | 760 | Yes | Yes | No |
| 1783-ETAP | 64 | N/A | N/A | N/A | 900 | No | Yes | No |
| 1783-ETAP1F, 1756-ETAP2F | 64 | N/A | N/A | N/A | 900 | No | Yes | Yes |
| 1794-AENT | 64 | 64 | N/A | 9500 | N/A | Yes | Yes | No |
| 2*x*-COMM-E | 30 | 16 | 16 | 400 | 50 | No | Yes | No |

(1) Total packet rate = I/O Produced Tag, max + HMI/MSG, max. Packet rates will vary depending on packet size. For more detailed specifications, see the EDS file for a specific catalog number.

(2) CIP connections for these devices can be used for all explicit or all implicit applications.
Example: A 1756-ENBT has a total of 64 CIP connections and can be used for any combination of connections.

(3) The number of TCP and CIP connections supported by the 1768-ENBT module depends on the firmware revision you are using. If you are using firmware revision 1.*x*, the module supports 32 TCP connections and 64 CIP connections. If you are using firmware revision 2.*x* or later, the module supports 64 TCP connections and 128 CIP connections.

**EtherNet/IP Network Specifications**

| Catalog Number | Produced/Consumed Tags | | Socket Services | Speed Duplex (Half/Full) | Duplicate IP Detection (starting revision) |
|---|---|---|---|---|---|
| | Number of Multicast Tags, Max | Unicast Available[1] | | | |
| 1734-AENT, 1734-AENTR | N/A | RSLogix 5000 programming software, version 18 | No | 10/100 | Revision 2.x - 1734-AENT<br><br>Revision 3.x - 1734-AENTR |
| 1738-AENT, 1738-AENTR | N/A | RSLogix 5000 programming software, version 18 | No | 10/100 | Revision 2.x - 1738-AENT<br><br>Revision 3.x - 1738-AENTR |
| 1756-ENBT | 32[2] | RSLogix 5000 programming software, version 16 | No | 10/100 | Revision 3.3 |
| 1756-EN2F | 32[2] | RSLogix 5000 programming software, version 16 | No | 10/100 | Revision 1.*x* |
| 1756-EN2T, 1756-EN2TR, 1756-EN2TXT | 32[2] | RSLogix 5000 programming software, version 16 - 1756-EN2T<br><br>RSLogix 5000 programming software, version 17.01 - 1756-EN2TR | No | 10/100 | Revision 1.*x* |
| 1756-EWEB | N/A | N/A | Yes | 10/100 | Revision 2.2 |
| 1768-ENBT | 32[2] | RSLogix 5000 programming software, version 16 | No | 10/100 | Revision 1.*x* |
| 1768-EWEB | N/A | N/A | Yes | 10/100 | Revision 1.*x* |
| 1769-L23E*x* | 32[2] | RSLogix 5000 programming software, version 17 | No | 10/100 | Revision 16 |
| 1769-L3*x*E | 32[2] | RSLogix 5000 programming software, version 16 | No | 10/100 | Revision 15 |
| 1783-ETAP | N/A | N/A | No | 10/100 | Revision 1.*x* |
| 1783-ETAP1F, 1783-ETAP2F | N/A | N/A | No | 10/100 | Revision 2.*x* |
| 1794-AENT | N/A | N/A | No | 10/100 | Revision 3.*x* |
| 2*x*-COMM-E | N/A | N/A | No | 10/100 | Revision 1.1 |

[1] These are the maximum number of I/O CIP connections.

[2] Each controller can send a maximum of 32 produced tags to one single consuming controller. If these same tags are sent to multiple consumers, the maximum number is 31.

**IMPORTANT**

Non-CIP communication requires 1756-EWEB, 1768-EWEB or MicroLogix 1400 embedded web server sockets.

For more information on the 1756-EWEB or 1768-EWEB modules, see the EtherNet/IP Web Server User Manual, publication ENET-UM527.

For more information on the enhanced MicroLogix 1400 controllers, see the MicroLogix 1400 Embedded Web Server User Manual, publication 1766-UM002

# Configure a Workstation to Operate on an EtherNet/IP Network

## Introduction

This chapter describes how to configure a workstation to operate on an EtherNet/IP network.

You need to load an Ethernet communication driver for all Rockwell Software applications to communicate with devices on an EtherNet/IP network. A workstation needs this driver to:

- upload and download controller projects over the EtherNet/IP network via RSLogix 5000 programming software.
- configure EtherNet/IP network parameters for devices on the network via RSNetWorx for EtherNet/IP software.
- collect controller data for PanelView terminals and RSView applications.

You can choose from any of three Ethernet drives:

- AB_ETHIP
- AB_ETH
- TCP

We recommend that you use the AB_ETHIP driver.

Before loading a communication driver, make sure:

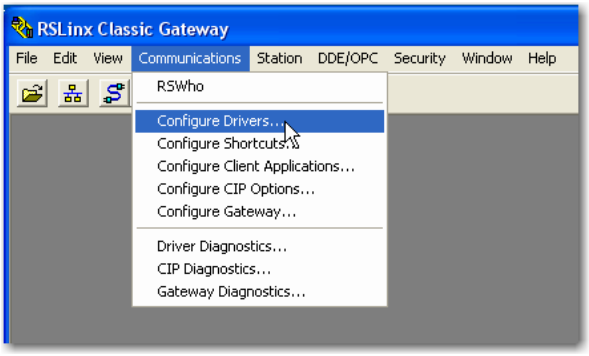
- the Ethernet communication card is already installed in the workstation.
- the IP address and other network parameters are correctly configured for the workstation.
- the workstation is properly connected to the EtherNet/IP network.

See the documentation for the appropriate Ethernet communication module for information on installing and configuring the module.

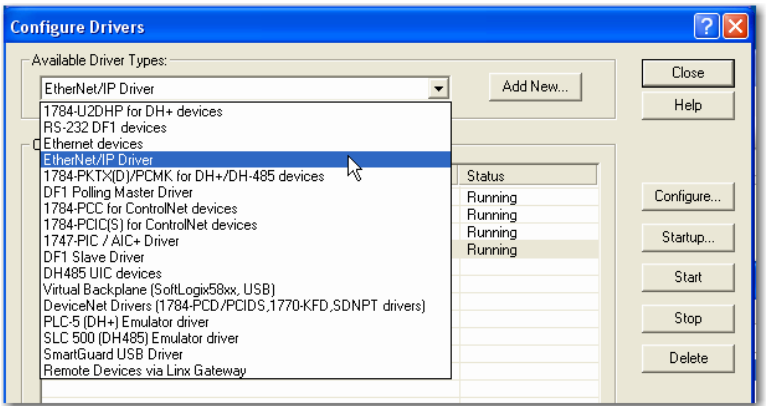
## Configure the Ethernet Communication Driver in RSLinx Software

To configure the Ethernet communication driver, perform this procedure.

1. In RSLinx software, from the Communications pull-down menu, choose Configure Drivers.

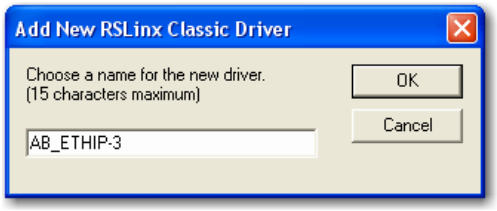



   The Configure Drivers dialog box appears.



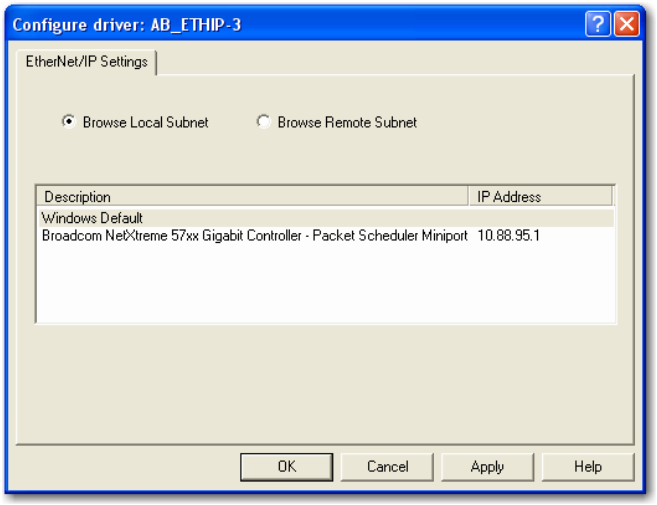

2. From Available Driver Types pull-down menu, choose EtherNet/IP Driver or Ethernet devices and click Add New.

   The Add New RSLinx Driver dialog box appears.



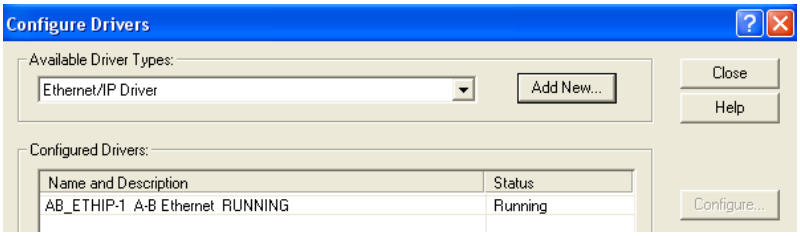

3. Type a name for the new driver and click OK.

The Configure driver dialog box appears.




4. Select Browse Local Subnet.
5. Click Apply.
6. Click OK.

This new driver is now available.



## Notes:

# Configure Stratix Switches

## Introduction

This chapter describes how you can use a Stratix switch.


| Topic | Page |
|---|---|
| Set Up the Hardware | 38 |
| Select a Switch | 37 |
| Switch Features | 38 |
| Additional Resources | 39 |


Stratix switches provide a rugged, easy-to-use, secure switching infrastructure for harsh environments. You can connect these switches to network devices such as servers, routers, and other switches. In industrial environments, you can connect any Ethernet-enabled industrial communication devices including programmable log controllers (PLC's), human-machine interfaces (HMI's), drives, sensors, and I/O.

## Select a Switch

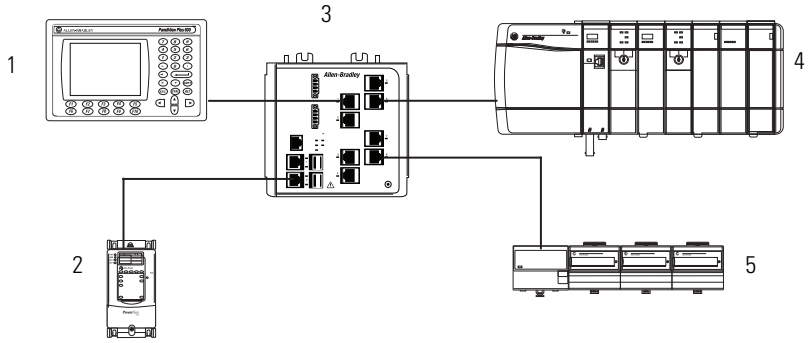
Select the switch depending on the application and environment.

| If your application | Select |
|---|---|
| • Integrates enterprise and manufacturing environments<br>• Requires I/O and Produced/Consumed communication<br>• Requires diagnostics data<br>• Requires security options | Stratix 8000 modular, managed switch |
| • Integrates plant floor devices<br>• Requires I/O and Produced/Consumed communication<br>• Require diagnostics data<br>• Requires security options | Stratix 6000 fixed, managed switch |
| • Requires easy set-up and direct relacement of switches<br>• Meets IP20 or IP67 standards | Stratix 2000 unmanaged switch |

## Set Up the Hardware

In this example, multiple Ethernet-enabled devices are connected via a Stratix switch.

**EtherNet/IP-enabled Devices Connected Via a Stratix Switch**




| Device | Description |
|---|---|
| 1 | HMI device |
| 2 | Drive |
| 3 | Stratix switch |
| 4 | Logix chassis |
| 5 | Distributed I/O |

## Switch Features

The features available vary according to the switch you select.

**Stratix Features**

| Switch | Configuration Features | Monitoring Features | Security Features | Maintenance Features |
|---|---|---|---|---|
| Stratix 8000 | • IT-friendly configuration tool – Cisco Command Line Interface, Cisco Network Assistant, Device Manager<br>• Express setup – quick start-up feature<br>• "Smartport" – easy switch port optimization feature<br>• Web enabled configuration using embedded web pages<br>• AOP configuration stored as part of project in RSLogix 5000 | • RSLogix 5000 pre-defined tags allow easy access for HMI development<br>• Sample face plates available for View applications | • Supports all security features available in the Cisco Catalyst line of switches including:<br>- 802.1x industry standard authentication<br>- MAC ID device authentication<br>- ACL (Access Control List)<br>- Port control | • Removable CompactFlash card holds OS and configuration of the switch which can be easily transferred to a new one<br>• Standard DHCP Option 82 support enables fixed IP address assignment to switch ports |

**Stratix Features**

| Switch | Configuration Features | Monitoring Features | Security Features | Maintenance Features |
|---|---|---|---|---|
| Stratix 6000 | • Default IP address allows quick start up<br>• Web enabled configuration using embedded web pages<br>• AOP configuration stored as part of project in RSLogix 5000 | • Real-time diagnostics available in embedded web pages<br>• RSLogix 5000 pre-defined tags allow easy access for HMI development<br>- Traffic level monitor w/ alarms<br>• Sample face plates available for View applications | • Supports all security features available inthe Cisco Catalyst line of switches including:<br>- Port control<br>- MAC ID device authentication<br>- Switch access username/password authentication | • Parameter settings held in Logix project and are automatically downloaded after switch replacement (IP address must be set prior to download)<br>• DHCP per port ensures connected devices are assigned the right addresses after replacement |
| Stratix 2000 | No parameters to configure for unmanaged switches | No diagnostics are available in unmanaged switches | No security features available in unmanaged switches | Direct replacement - no set-up or configuration required |

## Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

| Resource | Description |
|---|---|
| Stratix 8000 and 8300 Ethernet Managed Switches Installation Instructions, publication 1783-IN005 | Describes how to install and configure the switch. |
| Stratix 6000 Ethernet Managed Switches Installation Instructions, publication 1783-IN004 | Describes how to install and configure the switch. |
| Stratix 2000 Ethernet Unmanaged Switch Installation Instructions, publication 1783-IN001 | Describes how to install and configure the switch. |
| Stratix 8000 Ethernet Managed Switches Hardware User Manual, publication 1783-UM002 | Provides detailed information on installing and using your switches. |
| Stratix 8000 and 8300 Ethernet Managed Switches Sofware user Manual, publication 1783-UM003 | Provides detailed information on configuring and managing your switches. |
| Stratix 6000 Ethernet Managed Switch User Manual, publication 1783-UM001 | Provides detailed information on configuring and managing your switches. |
| Device Manager online help (provided with the switch) | Provides context-sensitive information on configuring and using the switch, including system messages. |

## Notes:

# Configure an EtherNet/IP Module to Operate on the Network

## Introduction

This chapter describes how to configure an EtherNet/IP communication module to operate on an EtherNet/IP network.


| Topic | Page |
|---|---|
| Determine Network Parameters | 41 |
| Set the IP Network Address | 43 |
| Assign Network Parameters via the BOOTP/DHCP Utility | 45 |
| Other Methods to Assign Network Parameters | 47 |
| Duplicate IP Address Detection | 51 |
| IP Address Swapping | 53 |
| DNS Addressing | 54 |
| Use EtherNet/IP Modules in a Logix5000 Controller Application | 55 |


When you first install a Rockwell Automation EtherNet/IP module, the module is BOOTP/DHCP enabled.

## Determine Network Parameters

To operate an EtherNet/IP network, you must define these parameters.

**EtherNet/IP Network Parameters**

| EtherNet/IP Network Parameter | Description |
|---|---|
| IP address | The IP address uniquely identifies the module. The IP address is in the form xxx.xxx.xxx.xxx where each xxx is a number from 0. . .255. However, there are some reserved values that you cannot use as the first octet in the address.<br>For example, you cannot use:<br>• 001.xxx.xxx.xxx<br>• 127.xxx.xxx.xxx<br>• 223 to 255.xxx.xxx.xxx |
| Subnet mask | Subnet addressing is an extension of the IP address scheme that allows a site to use a single network ID for multiple physical networks. Routing outside of the site continues by dividing the IP address into a net ID and a host ID via the class. Inside a site, the subnet mask is used to redivide the IP address into a custom network ID portion and host ID portion. This field is set to 0.0.0.0 by default.<br>If you change the subnet mask of an already-configured module, you must cycle power to the module for the change to take effect. |

**EtherNet/IP Network Parameters**

| EtherNet/IP Network Parameter | Description |
|---|---|
| Gateway | A gateway connects individual physical networks into a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. This field is set to 0.0.0.0 by default. |

If you use DNS addressing, or reference the module via host name in MSG instructions, define these parameters.

**EtherNet/IP Network Parameters for DNS Addressing**

| EtherNet/IP Network Parameter | Description |
|---|---|
| Host name | A host name is part of a text address that identifies the host for a module. The full text address of a module is *host_name.domain_name*. |
| Domain name | A domain name is part of a text address that identifies the domain in which the module resides. The full text address of a module is *host_name.domain_name*. The domain name has a 48-character limit.<br><br>If you specify a DNS server, you must enter a domain name. Also, if you send email from the module, some mail relay servers require a domain name during the initial handshake of the SMTP session. |
| Primary DNS server address | This identifies any DNS servers used in the network. You must have a DNS server configured if you specified a domain name or a host name in the module's configuration. The DNS server converts the domain name or host name to an IP address that can be used by the network.<br><br>For more information on DNS addressing, see page 54. |
| Secondary DNS server address | |

Check with your Ethernet network administrator to determine if you need to specify these parameters.

## Set the IP Network Address

EtherNet/IP modules ship with the IP address configuration switches set to 999 and DHCP enabled. You can set the network Internet Protocol (IP) address by:

- using the switches available on some modules.

**IMPORTANT**

The switches on 1783-ETAP, 1783-ETAP1F and 1783-ETAP2F taps are used somewhat differently than other EtherNet/IP modules.

For more information on how to use switches on the taps, see either of the following:

- EtherNet/IP Tap Installation Instructions, pubication 1783-IN007
- EtherNet/IP Fiber Tap Installation Instructions, publication 1783-IN008

- using a Bootstrap Protocol (BOOTP)/Dynamic Host Configuration Protocol (DHCP) server, such as the Rockwell Automation BOOTP-DHCP server utility.
- using RSLinx software or RSLogix 5000 programming software.

**IMPORTANT**

The adapter reads the configuration switches only when you cycle power to determine if the switches are set to a valid number.

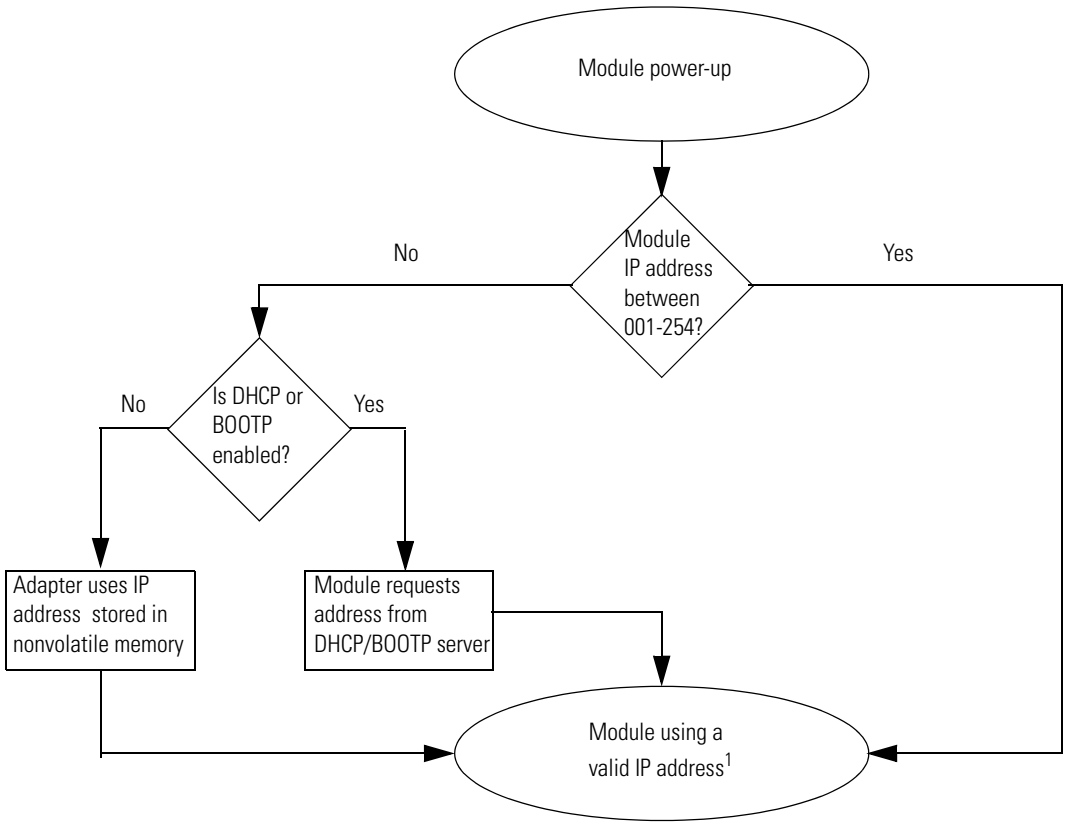
Valid settings range from 001...255, with some exceptions. There are some reserved values that you cannot use as the first octet in the address.

For example, you cannot use:

- 001.xxx.xxx.xxx
- 127.xxx.xxx.xxx
- 223 to 255.xxx.xxx.xxx

To restore the factory default settings on the module, set the switches to 888.

The graphic below shows how your module's IP address is set.




1 - If necessary, you can set the module switches to 888 to restore the IP address to the factory default value of 999. In this case, cycle power to the module after restoring the factory default settings and begin the flowchart process again.

For more detailed information, see the table below.

**IP Network Address Configuration Switch Settings**

| If the | Then |
|---|---|
| Switches are set to a valid number | • The adapter's IP address will be 192.168.1.xxx (where xxx represents the number set on the switches).<br>• The adapter's subnet mask will be 255.255.255.0, with the gateway address set to 0.0.0.0.<br>• The adapter will not havea host name assigned, or use any Domain Name System when using the thumbwheel settings. |
| Switches are set to an invalid number | • The module checks to see if DHCP or BOOTP is enabled. If either is, the module requests an IP address from a DHCP/BOOTP server. The DHCP/BOOTP server will also assign other Transport Control Protocol (TCP) parameters.<br>• If you have used software to preconfigure an IP address, and DHCP or BOOTP is disabled, the module will use the configured IP address. |
| DHCP is not enabled | • The adapter will use the IP address and any otherTCP configurable parameters stored in nonvolatile memory.<br>**Important:** The factory default switch setting is 999, and DHCP is enabled. |

## Assign Network Parameters via the BOOTP/DHCP Utility

By default, the EtherNet/IP module is BOOTP enabled. The BOOTP/DHCP utility is a standalone program that is located in the:

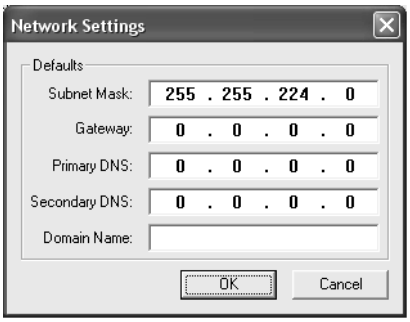
- BOOTP-DHCP Server folder accessed from the Start menu.
- Tools directory on the RSLogix 5000 installation CD.

**IMPORTANT** Before you start the BOOTP/DHCP utility, make sure you have the hardware (MAC) address of the module. The hardware address is on a sticker on the side of the EtherNet/IP module. The hardware address in a format similar to: 00-0b-db-14-55-35.

This utility recognizes BOOTP-enabled devices and provides an interface to configure a static IP address for each device.

To assign network parameters via the BOOTP/DHCP utility, perform this procedure.

1. Start the BOOTP/DHCP software.
2. Select Tool →Network Settings.
3. If appropriate for the network, enter the subnet mask, gateway address, primary/secondary server addresses, and domain name.

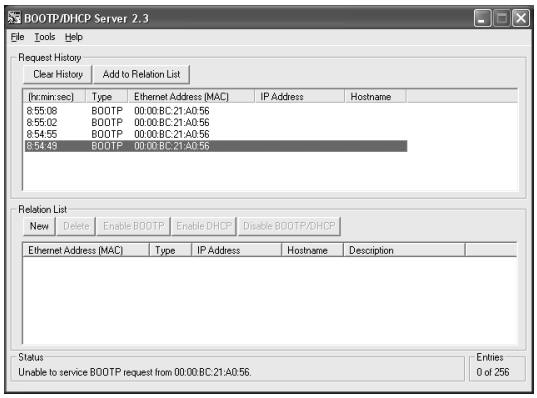



4. Click OK.

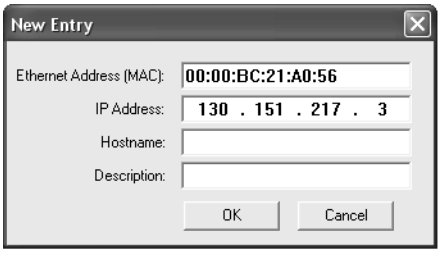
   The Request History panel displays the hardware addresses of modules issuing BOOTP requests.

5. Double-click the hardware (MAC) address of the module to be configured.

The hardware address is on a sticker on the side of the EtherNet/IP module. The format of the hardware address resembles 00-0b-db-14-55-35.




The New Entry window appears with the module's Ethernet Address (MAC).




6. Enter the IP address, host name, and a module description.

7. Click OK.

8. To permanently assign this configuration to the module, highlight the module and click the Disable BOOTP/DHCP button.

   When power is recycled, the module uses the assigned configuration and does not issue a BOOTP request.

   If you do not select the Disable BOOTP/DHCP button, on a power cycle, the host controller clears the current IP configuration and will again begin sending BOOTP requests.

## Other Methods to Assign Network Parameters

There are other methods to assign network parameters.

**Assignment of Network Parameters**

| If | Use this method for assigning network parameter | Page |
|---|---|---|
| • A BOOTP server is not available<br>• The EtherNet/IP module is connected to another NetLinx network | RSLinx software | 48 |
| The RSLogix 5000 project is online with the controller that communicates to or through the EtherNet/IP module | RSLogix 5000 programming software | 50 |
| DHCP is enabled (not BOOTP) for the EtherNet/IP module | DHCP software | 51 |
| You need to cycle power to your device for some reason | Thumbwheel switches | 43 |

These factors might affect your choice of method:

- Network isolation from or integration into the plant/enterprise network
- Network size

  For large networks, even isolated networks, it might be more convenient and safer to use a BOOTP/DHCP server rather than RSLogix 5000 or RSLinx software. The BOOTP/DHCP server also limits the possibility of assigning duplicate IP addresses.

- Company policies and procedures dealing with plant floor network installation and maintenance
- Level of involvement by IT personnel in plant floor network installation and maintenance
- Type of training offered to control engineers and maintenance personnel

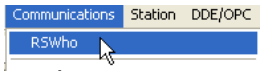
If you use the Rockwell Automation BOOTP or DHCP server in an uplinked subnet where an enterprise DHCP server exists, a module may get an address from the enterprise server before the Rockwell Automation utility even sees the module. You might have to disconnect from the uplink to set the address and configure the module to retain its static address before reconnecting to the uplink. This is not a problem if you have node names configured in the module and leave DHCP enabled.

## Configure the Module with RSLinx Software

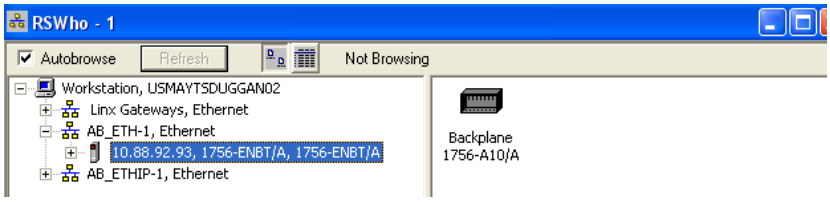
To use RSLinx software to configure the EtherNet/IP module, perform this procedure.

1. Make sure the module is installed and started.

2. In RSLinx software, from the Communications pull-down menu, choose RSWho.

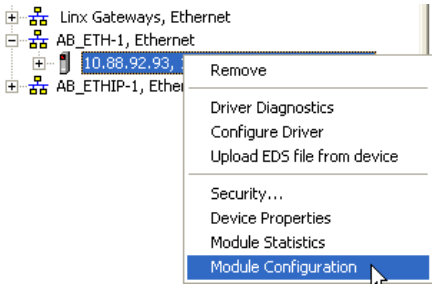



The RSWho dialog box appears.

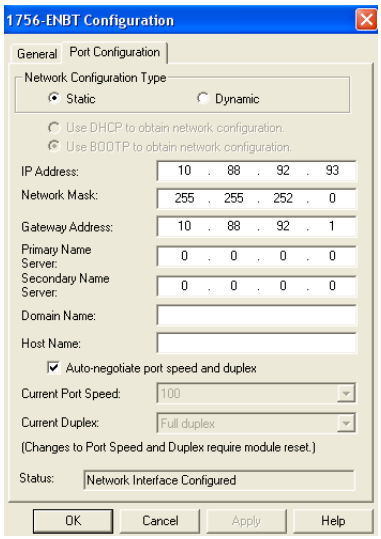



3. Navigate in RSWho to the Ethernet network.

4. Right-click the EtherNet/IP module and select Module Configuration.




The Module Configuration dialog box appears.


1756-ENBT Configuration
General
Port Configuration
Network Configuration Type
Static
Dynamic
Use DHCP to obtain network configuration.
Use BOOTP to obtain network configuration.
IP Address: 10 . 88 . 92 . 93
Network Mask: 255 . 255 . 252 . 0
Gateway Address: 10 . 88 . 92 . 1
Primary Name Server: 0 . 0 . 0 . 0
Secondary Name Server: 0 . 0 . 0 . 0
Domain Name:
Host Name:
Auto-negotiate port speed and duplex
Current Port Speed: 100
Current Duplex: Full duplex
(Changes to Port Speed and Duplex require module reset.)
Status: Network Interface Configured
OK
Cancel
Apply
Help

5. Click the Port Configuration tab.

6. For Network Configuration Type, select Static to permanently assign this configuration to the port.

**IMPORTANT** If you select Dynamic, on a power cycle, the controller clears the current IP configuration and resumes sending BOOTP requests.

   a. In the IP Address field, type the IP address.
   b. In the Network Mask field, type the network mask address.
   c. In the Gateway Address field, type the gateway address.
   d. In the Primary Name Server field, type the name of the primary server.
   e. In the Secondary Name Server field, type the name of the secondary server.
   f. In the Domain Name field, type the domain name.
   g. In the Host Name field, type the host name.

7. Configure the port settings.

| To | Then |
|---|---|
| Use the default port speed and duplex settings | Leave checked the Auto-negotiate port speed and duplex check box.<br><br>**Important:** The default port speed is 100, and the default duplex setting is Full. |
| Manually configure your port's speed and duplex settings. | a. Uncheck the Auto-negotiate port speed and duplex check box.<br><br>b. From the Current Port Speed pull-down menu, select a port speed.<br><br>c. From the Current Duplex pull-down menu, choose Half Duplex. |

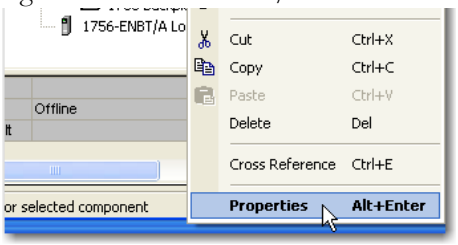
8. Click OK.

## Configure Your Module with RSLogix 5000 Software

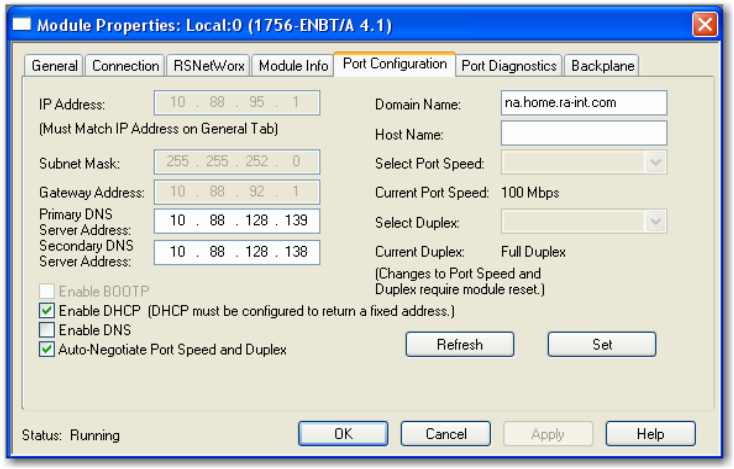
To use RSLogix 5000 programming software to configure the EtherNet/IP module, perform this procedure.

1. Make sure the module is installed, started and connected to the controller via a serial, or other network, connection.

2. In the Controller Organizer of RSLogix 5000 programming software, right-click the EtherNet/IP module and choose Properties.




   The Module Properties dialog box appears. The example screen below shows the Module Properties dialog box for the 1756-ENBT module.


Module Properties: Local:0 (1756-ENBT/A 4.1)
General
Connection
RSNetWorx
Module Info
Port Configuration
Port Diagnostics
Backplane
IP Address: 10 . 88 . 95 . 1
(Must Match IP Address on General Tab)
Subnet Mask: 255 . 255 . 252 . 0
Gateway Address: 10 . 88 . 92 . 1
Primary DNS Server Address: 10 . 88 . 128 . 139
Secondary DNS Server Address: 10 . 88 . 128 . 138
Domain Name: na.home.ra-int.com
Host Name:
Select Port Speed:
Current Port Speed: 100 Mbps
Select Duplex:
Current Duplex: Full Duplex
(Changes to Port Speed and Duplex require module reset.)
Enable BOOTP
Enable DHCP (DHCP must be configured to return a fixed address.)
Enable DNS
Auto-Negotiate Port Speed and Duplex
Refresh
Set
Status: Running
OK
Cancel
Apply
Help

3. Click the Port Configuration tab.

4. In the IP Address field, type the IP address.
   a. In the other fields, type the other network parameters, if needed.

   **IMPORTANT** The fields that appear vary from one EtherNet/IP module to another.

5. Click Apply.

6. Click OK.

## Use DHCP Software to Set the IP Address

Dynamic Host Configuration Protocol (DHCP) software automatically assigns IP addresses to client stations logging onto a TCP/IP network. DHCP is based on BOOTP and maintains some backward compatibility. The main difference is that BOOTP allows for manual configuration (static), while DHCP allows for both static and dynamic allocation of network addresses and configurations to newly attached modules.

Be cautious when using DHCP software to configure a module. A BOOTP client, such as the EtherNet/IP modules, can boot from a DHCP server only if the DHCP server is specifically written to also handle BOOTP queries. This is specific to the DHCP software package used. Consult your system administrator to see if a DHCP package supports BOOTP commands and manual IP allocation.

**ATTENTION**

The EtherNet/IP module must be assigned a fixed network address. The IP address of this module must not be dynamically provided.

Failure to observe this precaution may result in unintended machine motion or loss of process control.

# Duplicate IP Address Detection

Some EtherNet/IP modules (and their future revisions) support duplicate IP address detection.

| Cat. No. | Firmware Revision |
|---|---|
| 1734-AENT, 1734-AENTR | 2.1 and later |
| 1738-AENT, 1738-AENTR | 3.002 and later |
| 1756-ENBT | 3.2 and later |
| 1756-EN2F | 1.*x* and later |
| 1756-EN2T | 1.*x* and later |
| 1756-EN2TR | 1.*x* and later |
| 1756-EN2TRXT | 1.*x* and later |
| 1768-ENBT | 1.*x* and later |
| 1769-L2*x* | 17.01 and later |
| 1769-L32E and 1769-L35E | 15.01 and later |
| 1783-ETAP | 1.*x* and later |
| 1783-ETAP1F, 1783-ETAP2F | 2.*x* and later |

| Cat. No. | Firmware Revision |
|---|---|
| 1788-ENBT | 2.1 and later |
| 1794-AENT | Series A - 3.*x* and later<br><br>Series B - 4.1 and later |
| 2x-COMM-E | 1.1 and later |

When you change the IP address or connect one of these modules to an EtherNet/IP network, the module checks to make sure that the IP address assigned to this module does not match the address of any other network device. If the module determines that another device on the network with a matching IP address, the EtherNet/IP port of the module goes into conflict mode, where the module's:

- OK status indicator blinks red.
- Network (NET) status indicator is solid red.
- front display indicates the conflict (1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, and 1756-EN2TXT).

  The display scrolls:OK <IP_address_of_this_module> Duplicate IP <Mac_address_of_duplicate_node_detected>

  For example: OK 10.88.60.196 Duplicate IP - 00:00:BC:02:34:B4

To resolve this conflict, use the instructions in this chapter to change the IP address of the module. Then cycle power to the module or reset the modules, such as disconnecting and then reconnecting the EtherNet/IP cable cable.

Two modules could possibly detect a conflict simultaneously. If this occurs, perform this procedure.

1. Remove the module with the incorrect IP address or correct its conflict.
2. Cycle power to the second module or disconnect its EtherNet/IP cable
3. Reconnect the cable.

### Detection of Duplicate IP Addresses

Devices in conflict over an IP address behave differently depending on whether connections have been established to either of the modules and whether both modules support duplicate IP address detection.

**Device Conflict Over Duplicate IP Addresses**

| If | Then |
|---|---|
| Both modules support duplicate IP address detection | The first started module uses and retains its IP address.<br><br>The other module will detect a conflict, give up the IP address and enter conflict mode. |
| Both modules support duplicate IP address detection and are started at roughly the same time | They surrender the IP address and enter conflict mode |
| One module supports duplicate IP address detection and a second module does not | The second module generally keeps its IP address, regardless of which module first obtains the IP address.<br><br>The module that supports duplicate IP address detection will detect the conflict and give up the IP address. |

## IP Address Swapping

This EtherNet/IP modules supports IP address swapping in ControlLogix redundancy systems:

- 1756-ENBT, firmware revision 3.1 and later
- 1756-EN2T, firmware revision 2.003 and later
- 1756-EN2TR, firmware revision 2.x and later
- 1756-EN2TXT, firmware revision 2.1 and later

During a switchover in ControlLogix redundancy systems, these module swaps its IP address with its partner modules in the other redundant chassis.

For more information about IP address swapping, see the ControlLogix Redundancy User Manual, publication 1756-UM523. When using publication 1756-UM23, be aware that neither the 1756-EN2TR module nor the 1756-EN2TXT module supports redundancy.

## DNS Addressing

To further qualify a module's address, use DNS addressing to specify a host name for a module, which also includes specifying a domain name and DNS servers. DNS addressing makes it possible to set up similar network structures and IP address sequences under different domains.

DNS addressing is only necessary if you refer to the module by host name, such as in path descriptions in MSG instructions.

To use DNS addressing, perform this procedure.

1. Assign a host name to the module.

   A network administrator should be able to assign a host name. Valid host names should be IEC-1131-3 compliant.

2. Configure the module's parameters.

3. In addition to the IP address, subnet mask, and gateway address, configure a host name for the module, domain name, and primary/secondary DNS server addresses.

   In the DNS server, the host name must match the IP address of the module.

**IMPORTANT** Make sure the DNS enable bit is set.

If you configure your module using RSLinx software, version 2.41, the enable bit is cleared and DNS addressing will not work. If you configure your module using the Port Configuration tab in RSLogix 5000 programming software, the enable bit is set, so DNS addressing should work.

4. In RSLogix 5000 programming software, add the module to the I/O configuration tree.

   See Add a Moduleon page 79.

**IMPORTANT** If a child module resides in the same domain as its parent module, just enter the host name. If the child module's domain differs from that of its parent module, enter the host name and the domain name (host.domain)

**IMPORTANT** You can also use DNS addressing in a module profile in the I/O controller tree or in a message path. If the destination module's domain name differs from that of the source module, use a fully-qualified DNS name (hostname.domainname). For example, to send a message from ENBT1.location1.companyA to ENTB1.location2.companyA, the host names match, but the domains differ. Without the entry of a fully qualified DNS name, the module adds the default domain name to the specified host name.

## Use EtherNet/IP Modules in a Logix5000 Controller Application

After installing an EtherNet/IP module and setting its IP address, add the module to the Controller Organizer in an RSLogix 5000 project. This addition establishes I/O control.

You must download that project to the host controller before operation can begin. When the controller begins operation, it establishes a connection with the EtherNet/IP module. The module's configuration determines its behavior.

For more information on configuring and placing a workstation (for developing an RSLogix 5000 project) on an EtherNet/IP network, see Configure a Workstation to Operate on an EtherNet/IP Network on page 33.

For information on controlling I/O, see Control I/O on page 77.

# Configure a Supervisor on a Device-level Ring Network

## Introduction

A Device-level Ring (DLR) network is a single-fault tolerant ring network intended for the interconnection of automation devices.


| Topic | Page |
|---|---|
| Rockwell Automation Products with Embedded Switch Technology | 58 |
| Construct the Physical Network | 63 |
| Configure Supervisor Nodes on a DLR Network | 64 |
| Complete the Physical Connections of the Network | 74 |
| Verify Supervisor Configuration | 75 |
| Troubleshoot DLR Network Issues | 75 |


The ring topology provides:

- media redundancy.
- fast network fault detection and reconfiguration.
- the resiliency of a single-fault tolerant network.
- easy implementation without any additional hardware requirements.

**IMPORTANT**

This section describes how to configure a ring supervisor on a DLR network. This section does not fully describe a DLR network itself.

See the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005, for information on:

- a DLR overview.
- how to fully configure a DLR network.
- how to monitor a DLR network.
- how to troubleshoot a DLR network.

## Rockwell Automation Products with Embedded Switch Technology

The current Rockwell Automation products that you can use to construct a DLR or linear network include:

- 1756-EN2TR ControlLogix EtherNet/IP 2-port module - Allows ControlLogix controllers, I/O modules and communication modules to connect to the DLR or linear network.

- 1783 EtherNet/IP taps - Allow devices that do not support embedded switch technology to connect to a linear or a DLR network. Each tap uses a device port on the front of the tap to connect to devices that do not support the embedded switch technology to connect to linear or DLR networks. The taps have two network ports to connect to linear or DLR networks.

  The network ports used to connect to linear or DLR networks are different for each type of tap. The following table describes the types of taps used with each tap:

| Cat. No. | Network Ports | Description |
|---|---|---|
| 1783-ETAP | 2 copper | Two copper network ports connect the tap to copper linear or DLR networks. |
| 1783-ETAP1F | 1 copper<br>1 fiber | One copper network port connects the tap to a copper linear or DLR network, and one fiber-optic network port connects the tap to a fiber-optic linear or DLR network.<br><br>This tap is commonly used to connect a copper section with a fiber-optic section of the same network. |
| 1783-ETAP2F | 2 fiber | Two fiber-optic network ports connect the tap to a fiber-optic linear or DLR network. |

  The primary advantages of using fiber-optic networks is the availability of increased distances between network nodes and greater noise immunity on the network.

- 1734-AENTR, POINT I/O 2-port Ethernet adapter - Allows POINT I/O modules to connect to the DLR or linear network.

- 1738-AENTR, ArmorPOINT 2-port Ethernet adapter - Allows ArmorPOINT I/O modules to connect to the DLR or linear network.

- Any 1732E ArmorBlock I/O EtherNet/IP modules with a catalog number ending in R, including:
  - 1732E-IB16M12R
  - 1732E-OB16M12R
  - 1732E-16CFGM12R
  - 1732E-IB16M12DR
  - 1732E-OB16M12DR
  - 1732E-8X8M12DR
  - 1732E-IB16M12SOEDR

## Features Common to Products with Embedded Switch Technology

The products described on page 58 have certain features in common.

- Each product supports the management of network traffic to ensure timely delivery of critical data, that is, QoS and IGMP protocols are supported.
- Each product is designed according to the open ODVA specification for EtherNet/IP. Because of this design, third-party products may be designed, according the ODVA specification, to operate on a DLR or linear network. To see the ODVA specification, go to:

  http://www.odva.org/
- For DLR networks, ring recovery time is less than 3ms for a 50-node ring.

- Each product supports a 1588 transparent clock for CIP motion and CIP Sync applications.

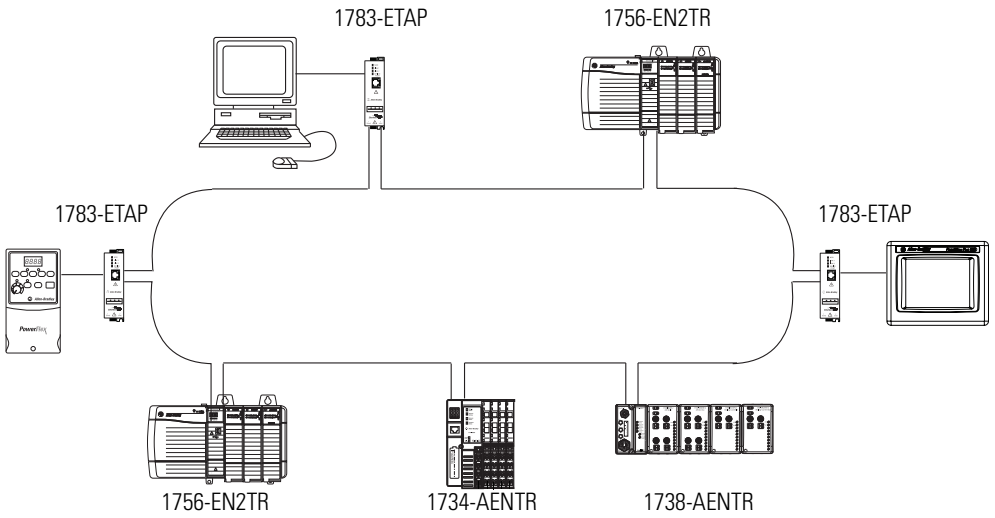
  CIP Sync technology can be used in Logix control systems to synchronize clocks across a system operating on the EtherNet/IP network. This technology supports highly distributed applications that require such functions as timestamping, sequence of events recording, distributed motion control, and increased control coordination.

  For example, with CIP Sync technology, a single ControlLogix controller can establish a master time and then, using ControlLogix Ethernet modules, propogate that time to all necessary devices on the network.

  For more information on how to use CIP Synch technology, see the Integrated Architecture and CIP Sync Configuration Application Solution, publication IA-AP003.

- Each of the products described on page 58 has 2 ports to connect to a linear or DLR network in a single subnet. You cannot use these ports as two Network Interface Cards (NICs) connected to two different subnets.

**Example Device-level Ring Topology**




## Supervisor Node

A DLR network requires at least one node to be configured as ring supervisor. Currently, two Rockwell Automation products support the ring supervisor functionality.

- 1756-EN2TR, ControlLogix EtherNet/IP 2-port module
- 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP taps

**IMPORTANT** Out of the box, the supervisor-capable devices have their supervisor function disabled so they are ready to participate in either a linear/star network topology, or as a ring node on an existing DLR network.

In a DLR network, you must configure at least one of the supervisor-capable devices as the ring supervisor before physically connecting the ring. If not, the DLR network will not work.

### *Active Ring Supervisor*

When multiple nodes are enabled as supervisor, the node with the numerically highest precedence value becomes the active ring supervisor; the other nodes automatically become back-up supervisors.

The ring supervisor provides two main functions:

- Manage traffic on the DLR network
- Collect diagnostic information for the network

### *Back-up Supervisor Node*

At any point in time, there will only be one active supervisor on a DLR network. However, we recommend that you can configure at least one other supervisor-capable node to act as back-up supervisor nodes. During normal operation, a back-up supervisor behaves like a ring node. If the active supervisor node faults, the back-up supervisor with the next numerically highest precedence becomes the active supervisor.

If multiple supervisors are configured with the same precedence value (the factory default value for all supervisor-capable devices is 0), the node with the numerically highest MAC address becomes the active supervisor.

**IMPORTANT** While a back-up supervisor is not required on a DLR network, we recommend that you configure at least one ring supervisors for your ring network.

We recommend that you:

- configure at least one back-up supervisor.
- configure your desired active ring supervisor with a numerically higher precedence value as compared to the back-up supervisors.
- keep track of your network's supervisor-precedence values for all supervisor-enabled nodes.

For more information about how to configure a supervisor, see Configure Supervisor Nodes on a DLR Network on page 64.

## Ring Node

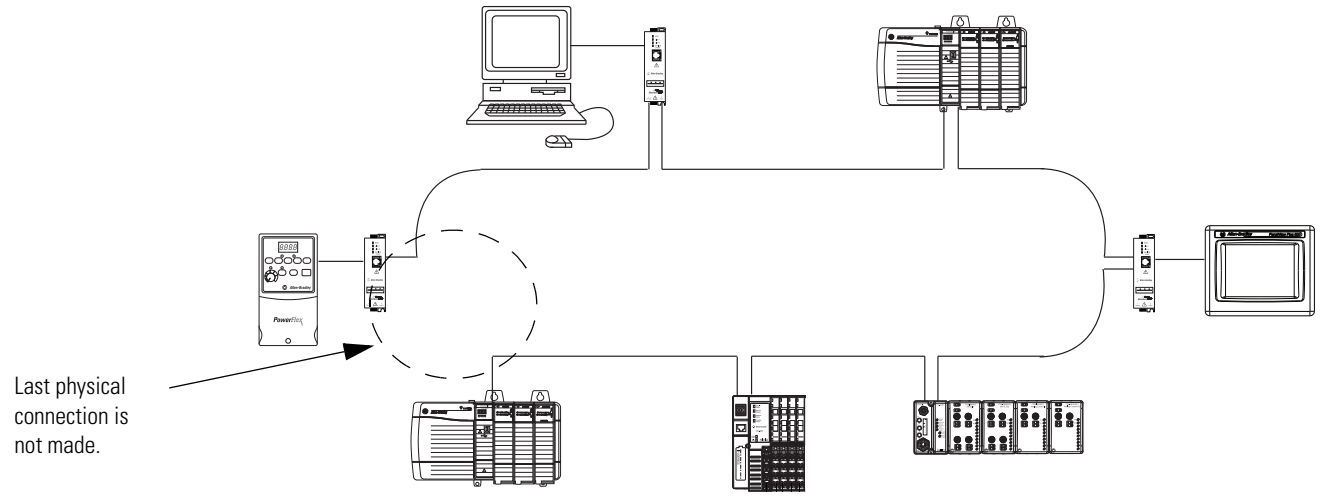
A ring node is any node that operates on the network to process data that is transmitted over the network or to pass on the data to the next node on the network. When a fault occurs on the DLR network, these reconfigure themselves and relearn the network topology. Additionally, ring nodes can report fault locations to the active ring supervisor.

## Construct the Physical Network

The first thing you must do to create a new DLR network is physically connect all necessary devices to the network. However, you should leave at least one connection unmade, that is, temporarily omit the physical connection between two nodes on the ring, as the factory default settings of DLR devices are set to operate in linear/star mode or as ring nodes on existing DLR networks.

The figure below shows an example of a new DLR network with one physical connection left open.

**Example Device-level Ring Topology with One Connection Left Unmade**



## Configure Supervisor Nodes on a DLR Network

After you have installed all devices on the DLR network, you must configure the supervisor node. Ring nodes do not require any configuration.

Before you can complete a DLR network, that is, configure all devices on the network and make all physical connections, you must configure and enable a ring supervisor in:

- RSLogix 5000 programming software

  or

- RSLinx Classic communication software

This section shows how to use RSLogix 5000 programming software, beginning on page 65, and RSLinx Classic communication software, beginning on page 71, to configure and enable a ring supervisor. When using either software, the 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F taps have additional configuration parameters.

**IMPORTANT** In addition to using the software listed above to configure and enable a ring supervisor, you can use the DIP switches on your tap to automatically configure the tap to be a ring supervisor.

For more information on how to use the DIP switches on your EtherNet/IP tap, see the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.

## Configure a Ring Supervisor in RSLogix 5000 Programming Software

To configure the 1756-EN2TR module or the 1783-ETAP, 1783-ETAP1F or 1783-ETAP2F taps as a ring supervisor, use the device's Add-on Profile (AOP) in RSLogix 5000 programming software, version 17.01.

**IMPORTANT**

To download AOP's, go to: http://support.rockwellautomation.com/controlflash/LogixProfiler.asp

Depending on the firmware revision of your product, you must use a specific AOP version.

| Cat. No. | Firmware Revision | Required Add-on Profile Revision |
|---|---|---|
| 1756-EN2TR | 2.1(1) | 1.x or later |
| | 3.x or later | 2.x or later |
| 1783-ETAP | 1.1(2) | 1.x or later |
| | 2.x or later | 2.x or later |
| 1783-ETAP1F | 2.x or later | 2.x or later |
| 1783-ETAP2F | | |

(1) You can use the ControlFLASH Firmware Upgrade software to upgrade a 1756-EN2TR module from firmware revision 2.1 to 3.x or later.

(2) You can use the ControlFLASH Firmware Upgrade software to upgrade a 1783-ETAP tap from firmware revision 1.1 to 2.x or later.

To download new firmware, go to: http://www.rockwellautomation.com/support/americas/index_en.html

If you upgrade the firmware revision on your module or tap, you must use the required AOP revision listed above for that revision. For example, if you upgrade your 1756-EN2TR module to firmware revision 3.x or later, you must use AOP revision 2.x or later in your RSLogix 5000 programming software.

Additionally, if you upgrade the firmware revision on your module or tap, you must also use the required RSLinx communication software for that firmware revision. For more information on which RSLinx communication software version is required for each firmware revision, see page 71.

For both the 1756-EN2TR module and 1783-ETAP tap, make sure that the Major Revision configured on the General tab of the device's RSLogix 5000 programming software configuration matches the major revision of the physical module.

If the device configuration on the General tab does not match the physical module, the programming software alerts you to this mismatch when you attempt to configure the Internet Protocol, Port Configuration and Network tabs for that device.

To configure the ring supervisor in RSLogix 5000 programming software, follow these steps.

**IMPORTANT**

The steps to configure a ring supervisor via software are basically the same for the 1756-EN2TR module and the 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F taps. This example shows how to configure the 1756-EN2TR module.

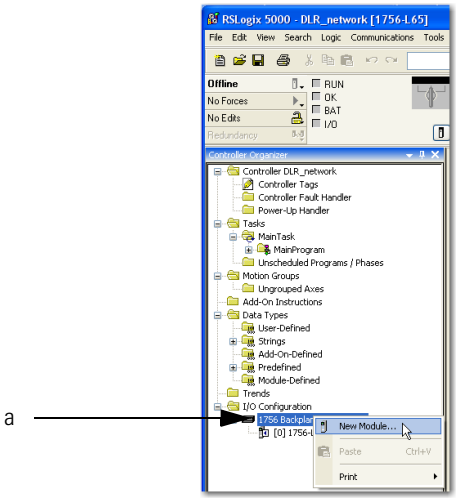
You need to configure only the 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F taps in your I/O Configuration if you plan to enable the tap as a ring supervisor. If you do not plan to use the tap as a ring supervisor, we recommend that you do not add it to your I/O Configuration.

Additionally, if you want to configure a 1783-ETAP, 1783-ETAP1F, or 1783-ETAP2F tap as a supervisor via software or with its DIP switchs, you must first assign it an IP address. The tap does not require an IP address if it is used as a ring node or has its supervisor function enabled by DIP switch

For more information on how to use a tap's switch to configure it as a ring supervisor, see the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.

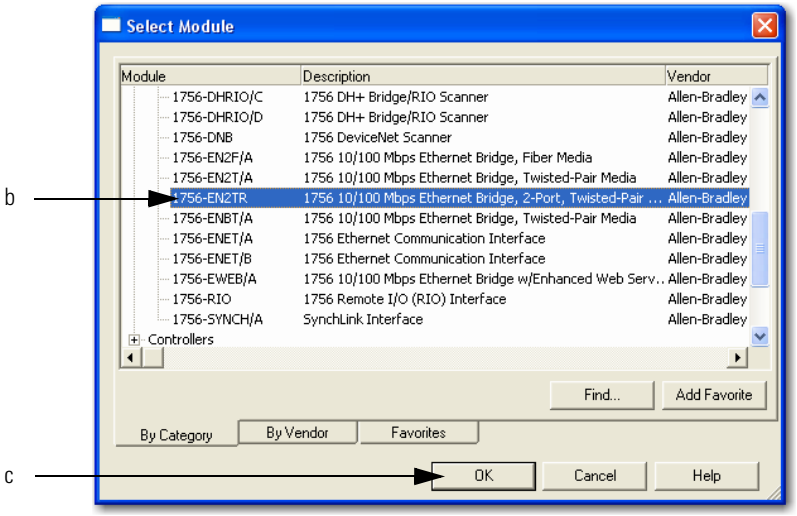
1. Add the module to your project.

   a. Right-click 1756 Backplane and choose New Module.



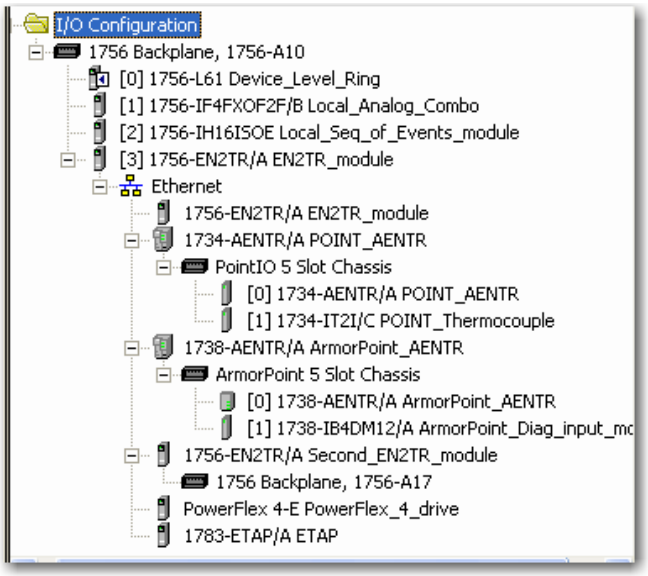
b. Select the module.

c. Click OK.




2. Complete configuration information for the module in your RSLogix 5000 project.

The graphic below shows the I/O configuration for an example DLR network.




3. Download to your Logix controller.

4. Go online with the controller and leave it in Program mode.

## Enable Ring Supervisor in RSLogix 5000 Programming Software

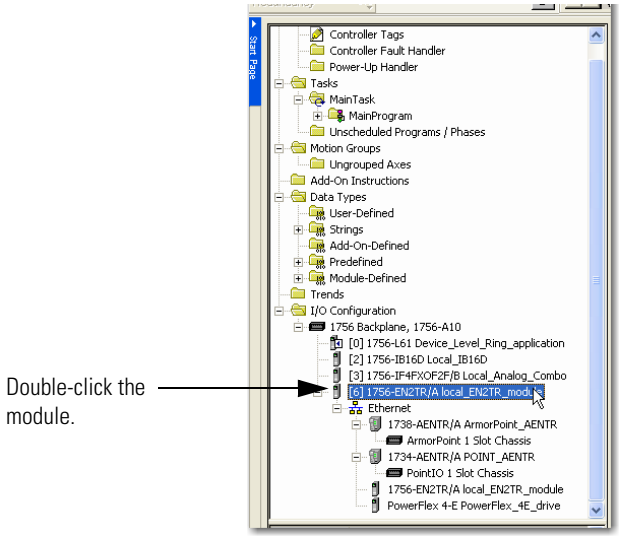
To enable a ring supervisor, you must use an AOP in RSLogix 5000 programming software, version 17.01. After you have added your 1756-EN2TR module or 1783-ETAP, 1783-ETAP1F, or 1783-ETAP2F tap to your RSLogix 5000 project, you must enable the ring supervisor.

**IMPORTANT** If you are using RSLogix 5000 programming software to configure your ring supervisor and monitor diagnostics of your DLR network, you must be online with your controller.

To enable the 1756-EN2TR module or 1783-ETAP, 1783-ETAP1F, or 1783-ETAP2F tap as a ring supervisor, follow these steps.

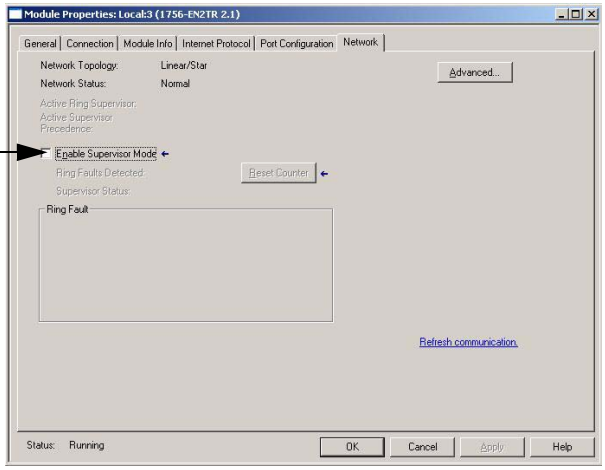
**IMPORTANT** The steps to enable a ring supervisor are basically the same for both the 1756-EN2TR module and the 1783-ETAP, 1783-ETAP1F, or 1783-ETAP2F tap. This example shows how to do it for the 1756-EN2TR module.

1. With your project online with the controller, double-click a supervisor-capable device in the I/O configuration tree.



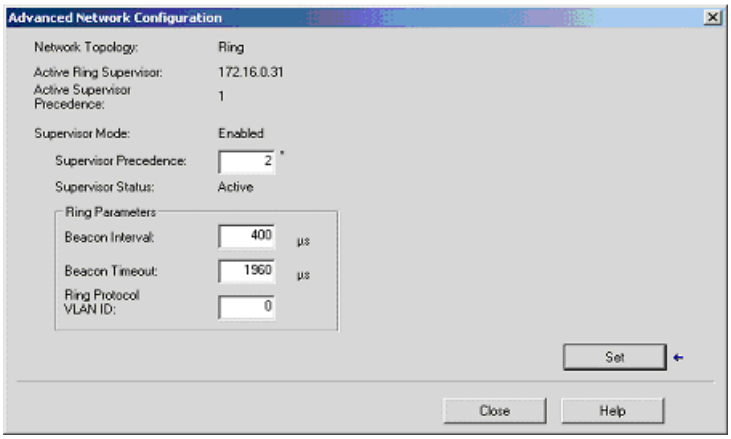
**2.** Click the Network tab to enable Supervisor Mode.

Click here to enable Supervisor Mode.




Configuration takes affect immediately; you do not need to click Apply or OK.

**3.** Click the Advanced button to configure supervisor-related parameters, as shown in the screen shot below.




For the Supervisor Precedence parameter, you must click Set after entering a value.

**4.** Click Set.

**IMPORTANT** For Beacon Interval, Beacon Timeout and Ring Protocol VLAN ID, we recommend that you only use the default values.

| Functionality | Description | Default Setting |
|---|---|---|
| Supervisor Precedence | You must configure a supervisor precedence number for each device configured as a ring supervisor. The highest possible supervisor precedence value is 255.<br><br>When multiple nodes are enabled as supervisor, the node with the highest precedence value is assigned as the active ring supervisor; the other nodes automatically become back-up supervisors.<br><br>We recommend that you:<br>• configure back-up supervisor nodes.<br>• set your desired Active Ring Supervisor with a relatively high supervisor-precedence value compared to the back-up nodes.<br>• keep track of your network's supervisor-precedence values.<br><br>If multiple supervisors are configured with the same precedence value (the factory default value for all supervisor-capable devices is 0), the node with the numerically highest MAC address becomes the active supervisor. | 0 |
| Beacon Interval | Frequency of the active ring supervisor transmitting a beacon frame through both of its Ethernet ports. This parameter is user configurable for any time between 200μS and 100mS. | 400 μS |
| Beacon Timeout | The beacon timeout is amount of time nodes wait before timing out the reception of beacon frames and taking appropriate action. Supervisors support a range from 400μS to 500mS. | 1960 μS |
| Ring Protocol VLAN ID | Reserved for future use. | 0 |

## Configure and Enable a Ring Supervisor in RSLinx Classic Communication Software

You can configure and enable a ring supervisor for your DLR network through RSLinx Classic communication software.

**IMPORTANT** Depending on the firmware revision of your product, you must use specific versions of RSLinx communication software.

| Cat. No. | Firmware Revision | Required RSLinx Commmunication Software Version |
|---|---|---|
| 1756-EN2TR | 2.1[1] | 2.55 or later |
| | 3.x or later | 2.56 or later |
| 1783-ETAP | 1.1[2] | 2.55 or later |
| | 2.x or later | 2.56 or later |
| 1783-ETAP1F | 2.x or later | 2.56 or later |
| 1783-ETAP2F | | |

(1) You can use the ControlFLASH Firmware Upgrade software to upgrade a 1756-EN2TR module from firmware revision 2.1 to 3.x or later.

(2) You can use the ControlFLASH Firmware Updgrade software to upgrade a 1783-ETAP tap from firmware revision 1.1 to 2.x or later.

To download new firmware, go to: http://www.rockwellautomation.com/support/americas/index_en.html

If you upgrade the firmware revision on your module or tap, you must use the required RSLinx communication software version listed above for that firmware revision. For example, if you upgrade your 1756-EN2TR module to firmware revision 3.x or later, you must use RSLinx communication software, version 2.56 or later.

Additionally, if you upgrade the firmware revision on your module or tap, you must also use the required AOP revision for that firmware revision. For more information on which AOP revision is required for each firmware revision, see page 65.

This example is for the 1783-ETAP tap. Follow these steps.

1. Launch RSLinx communication software.

2. Browse to the DLR network that you are setting up.

**TIP**

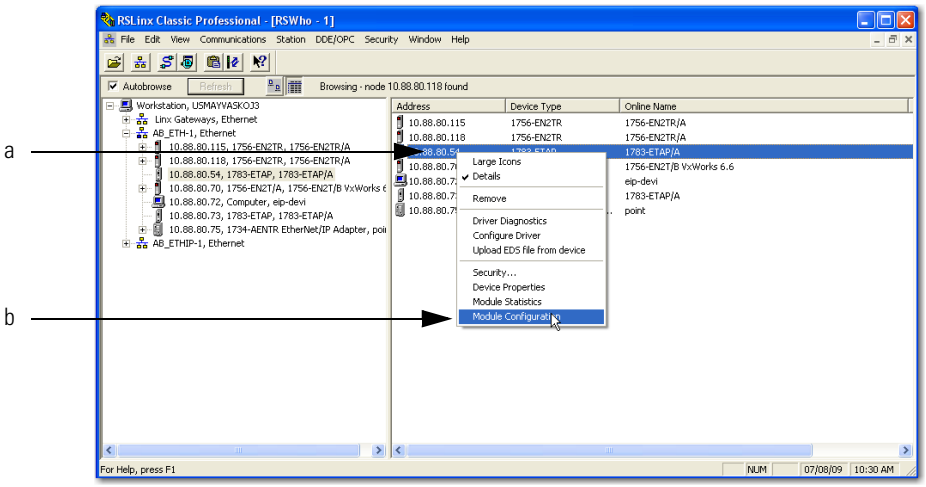
If you do not have the Electronic Data Sheet (EDS) file installed on the module configured to be the ring supervisor, it will appear with a question mark (?). To obtain and use the EDS file:

- right-click the module and choose to upload the EDS file from the device.

or

- download the EDS file from: http://www.rockwellautomation.com/resources/eds/

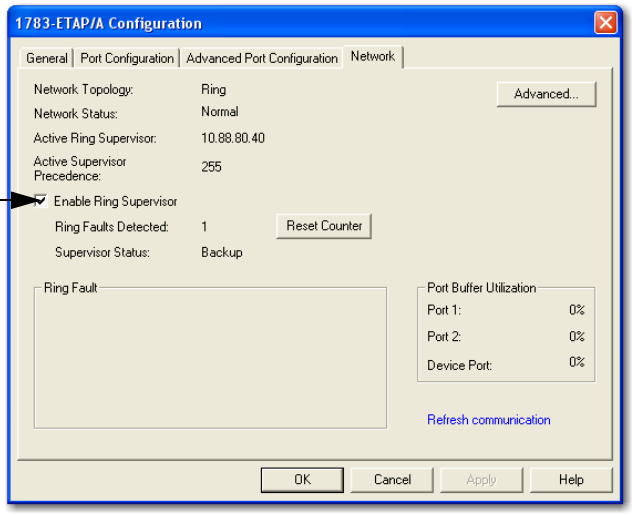
3. Access the supervisor-capable node's properties.
   a. Right-click the node.
   b. Choose Module Configuration.




The General tab appears with information about the module that is not configurable.

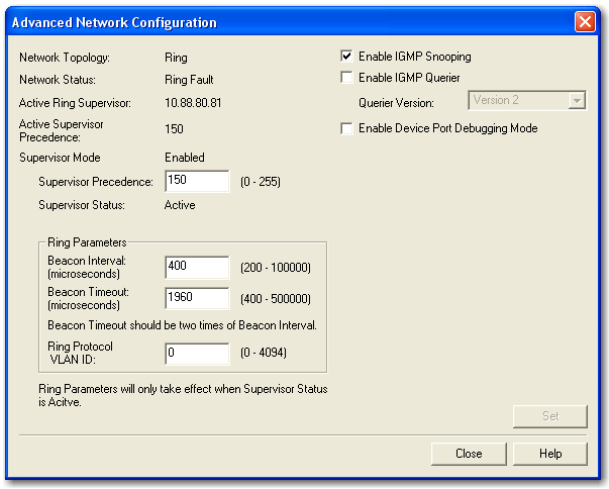
4. Click the Network tab to enable Supervisor Mode.

Click here to enable Supervisor Mode.




Configuration takes affect immediately; you do not need to click Apply or OK.

5. Click the Advanced button to configure supervisor-related parameters.


Advanced Network Configuration
Network Topology: Ring
Network Status: Ring Fault
Active Ring Supervisor: 10.88.80.81
Active Supervisor Precedence: 150
Supervisor Mode Enabled
Supervisor Precedence: 150 (0 - 255)
Supervisor Status: Active
Enable IGMP Snooping
Enable IGMP Querier
Querier Version: Version 2
Enable Device Port Debugging Mode
Ring Parameters
Beacon Interval: (microseconds) 400 (200 - 100000)
Beacon Timeout: (microseconds) 1960 (400 - 500000)
Beacon Timeout should be two times of Beacon Interval.
Ring Protocol VLAN ID: 0 (0 - 4094)
Ring Parameters will only take effect when Supervisor Status is Acitve.
Set
Close
Help

6. Click Set.

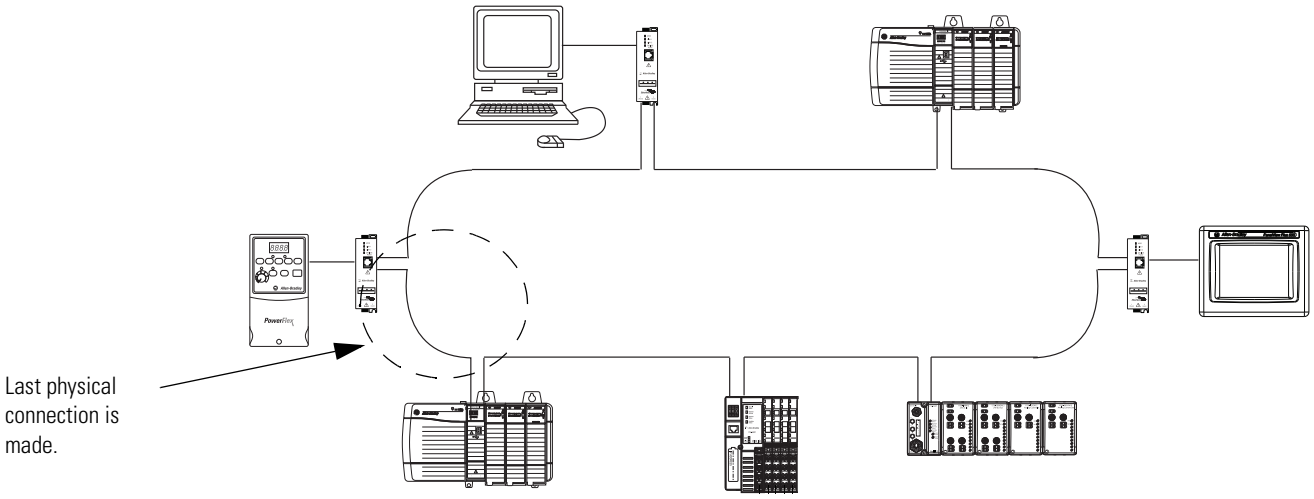
**IMPORTANT** For Beacon Interval, Beacon Timeout and Ring Protocol VLAN ID, we recommend that you only use the default values.

## Complete the Physical Connections of the Network

After you configure and enable your ring supervisor nodes, you must complete the physical connection of your new DLR network to make it complete and fully functional.

The figure below shows an example DLR network with all physical connections complete.

**Example Device-level Ring Topology with All Connections Complete**

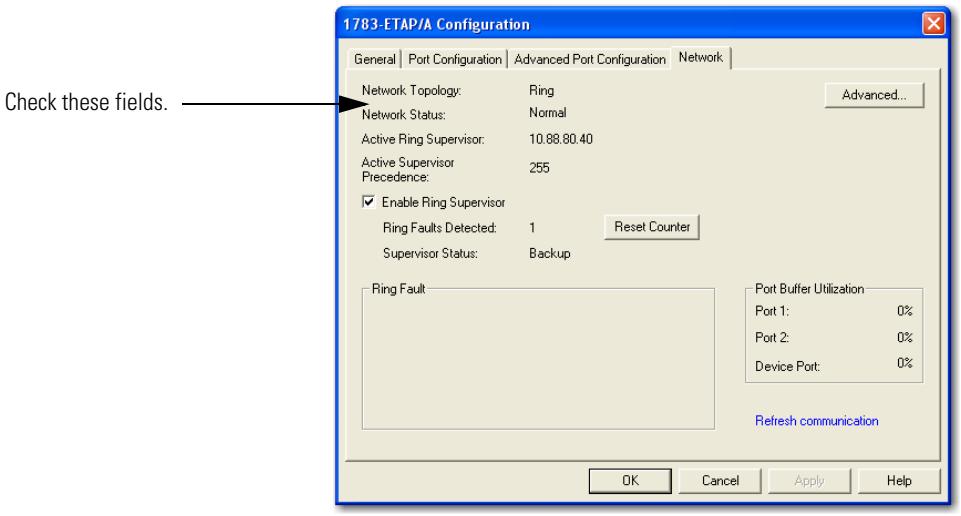


## Verify Supervisor Configuration

You may want to verify that your supervisor configuration has taken place and that the ring network is functioning properly. You can verify that configuration and a normally functioning network in either RSLogix 5000 programming software or RSLinx Classic software.

1. Access the module properties as shown previously in this chapter.
2. Click the Network tab.
3. Check the Network Topology and Network Status fields.

   They should display Ring and Normal respectively, as shown below.




For a 1756-EN2TR module, you can also verify the supervisor configuration through the module's diagnostic web pages. For more information on monitoring diagnostics via an EtherNet/IP module's web pages, see Monitor Diagnostics on page 137.

## Troubleshoot DLR Network Issues

For a full description of how to troubleshoot DLR network issues, such as replacing a node on a DLR network, see the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.

# Control I/O

## Introduction

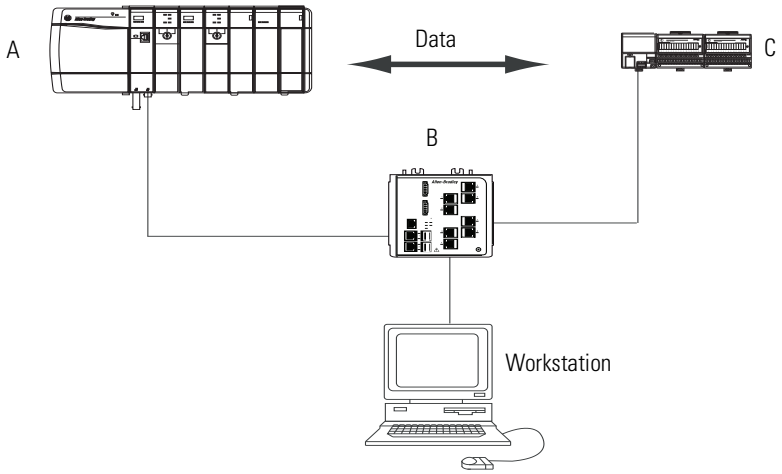
This chapter describes how a controller controls distributed I/O over an EtherNet/IP network. The controller requires a communication module to connect to the network. Distributed I/O modules require an adapter to connect to the network.


| Topic | Page |
|---|---|
| Set Up the Hardware | 77 |
| Select a Remote Adapter | 87 |
| Set the Requested Packet Interval (RPI) | 88 |
| Access Distributed I/O | 90 |


## Set Up the Hardware

In this example, the Logix5000 controller has an EtherNet/IP communication module to connect to the EtherNet/IP network. The distributed (remote) I/O has an EtherNet/IP adapter to connect it to the EtherNet/IP network.

**Distributed I/O over an EtherNet/IP Network**




| Item | Description |
|---|---|
| A | Local chassis containing a Logix5000 Controller with EtherNet/IP Communication Module |
| B | Switch |
| C | Remote chassis containing distributed I/O modules with an EtherNet/IP adapter |

The Logix5000 controller can communicate with each I/O module directly (direct connection). Or you can configure a rack-optimized connection to the EtherNet/IP adapter to send data to any digital I/O modules. Analog modules always require direct connections.

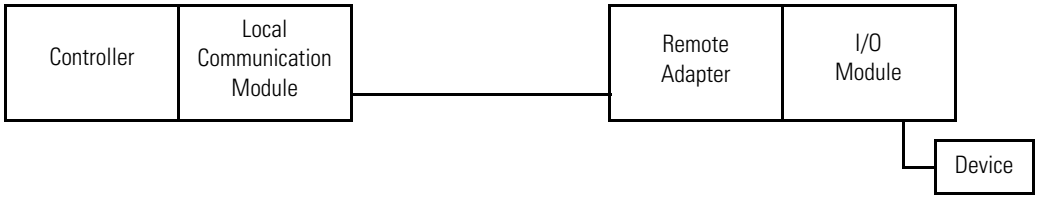
You must:

- set the IP addresses for each EtherNet/IP module.
- connect all wiring and cabling properly.
- configure the communication driver (such as AB-ETHIP-1) for the programming workstation.

## Add Distributed I/O

To communicate with a system's I/O modules, add bridge, adapter, and I/O modules to the controller's I/O Configuration folder. Within the folder, organize the modules into a hierarchy (tree/branch, parent/child).

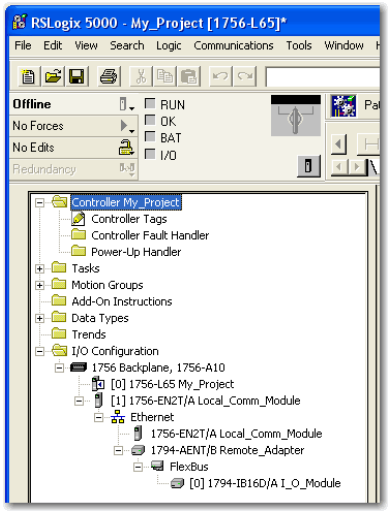
For a typical distributed I/O network, such as the one shown below,




you build the I/O configuration with the following steps.

1. Add the local communication module, that is, the bridge.
2. Add the remote adapter for the distributed I/O chassis or DIN rail.

3. Add the I/O module.

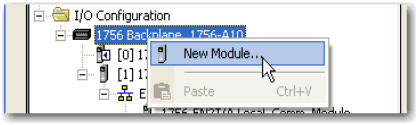



**IMPORTANT** I/O is controlled on the same subnet and can't be processed via a router.

## Add a Module

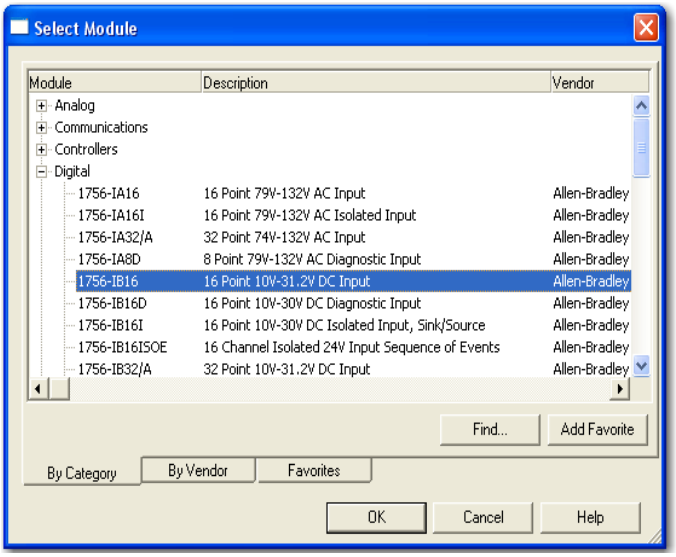
To add a module to the I/O Configuration folder, perform this procedure.

1. In the Controller Organizer of RSLogix 5000 programming software, right-click branch to which you want to add the module and choose New Module.

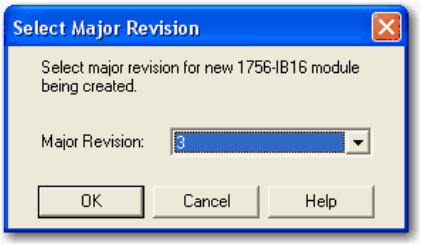



The Select Module dialog box appears.

2. Expand the module type and choose the module you wish to add and click OK.

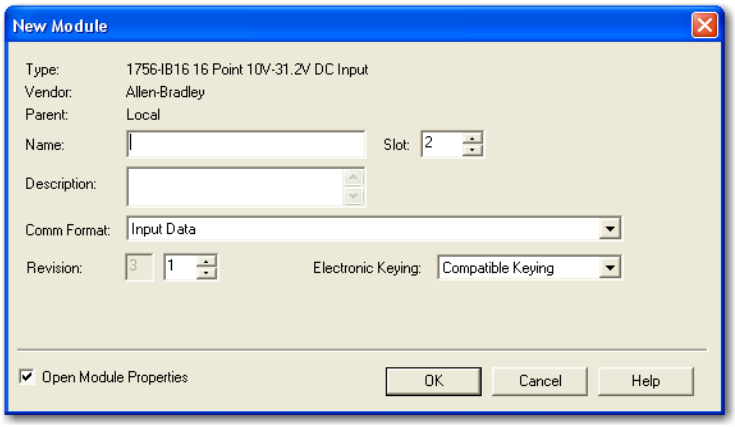



The Select Major Revision dialog box appears.



3. From the Major Revision pull-down menu, choose the major revision of the I/O module you want to add and click OK.

   The Module Properties dialog box appears.




4. In the Name field, type the name of your I/O module.

5. In the Slot field, type the slot number in which your I/O module will reside.

6. From the Comm Format pull-down menu, choose a communication format.

   For more information on the selection of communication formats, see Set the Requested Packet Interval (RPI) on page 88.

7. Click OK to see the rest of the Module Properties dialog boxs.

8. Configure the module as necessary.

9. Click Finish.

## Select a Communication Format

When configuring an I/O module, select its communication format. The chosen communication format determines the data structure for the module's tags. Many I/O modules support different formats. Each format uses a different data structure. The chosen communication format determines:

- direct or rack-optimized connection.
- ownership.

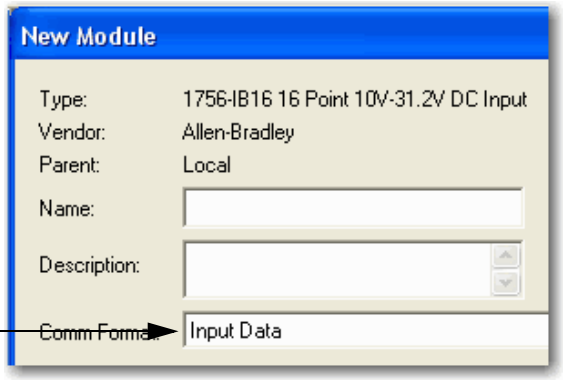
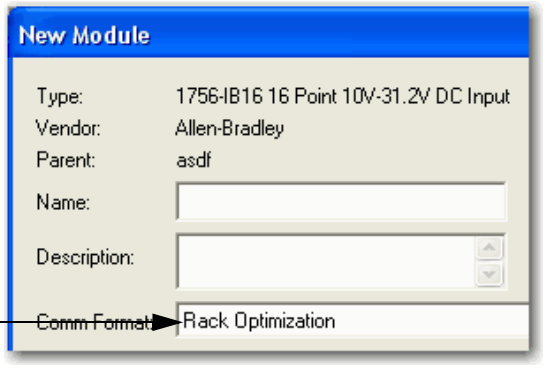
**Communication Formats**

| Type of I/O module | Desired Connection Type | Required Communication Format That Specifies |
|---|---|---|
| Digital | A rack-optimized connection | Rack Optimization |
| | To use specialty features of the module, such as diagnostics, timestamps, or electronic fuses | Full Diagnostics<br>CST Timestamped |
| Digital | A direct connection | Scheduled Data<br>Input Data<br>Output Data |
| Analog | A direct connection<br>(only direct connection is supported for analog modules) | Float Data<br>Integer Data<br>CST Timestamped |

See online help in RSLogix 5000 programming software for specific communication formats per I/O module.

## Choosing a Direct or Rack-optimized Connection

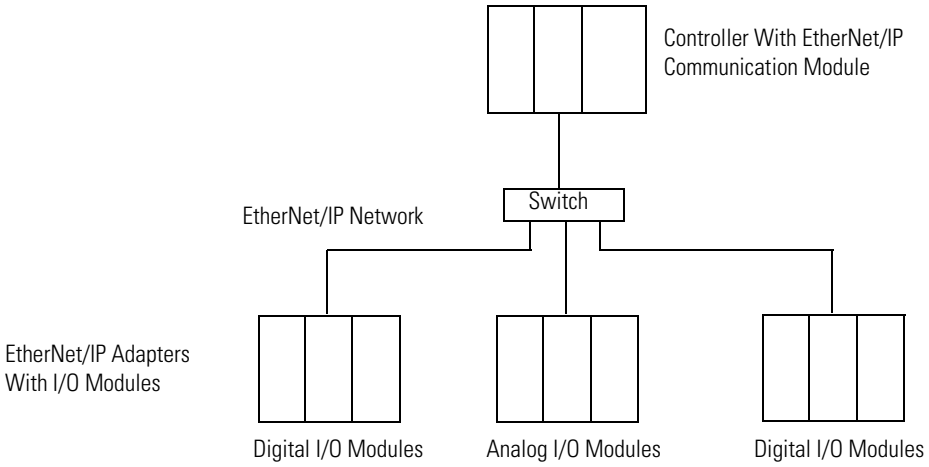
The Logix5000 controller uses connections to transmit I/O data. These connections can be direct connections or rack-optimized connections.

| Term | Definition |
|---|---|
| Direct connection | A direct connection is a real-time, data transfer link between the controller and an I/O module. The controller maintains and monitors the connection with the I/O module. Any break in the connection, such as a module fault or the removal of a module while under power, sets fault bits in the data area associated with the module.<br>A direct connection is any connection that does not use the Rack Optimization Comm Format.<br>  |
| Rack-optimized connection | For digital I/O modules, you can select rack-optimized communication. A rack-optimized connection consolidates connection usage between the controller and all the digital I/O modules in the chassis (or DIN rail). Rather than having individual, direct connections for each I/O module, there is one connection for the entire chassis (or DIN rail).<br>Rack-optimized connection<br>  |

**IMPORTANT** If you use various 1756 EtherNet/IP communication modules in a remote chassis, such as a 1756-ENBT with a 1756-EN2T, do not use the rack-optimized communication format with this remote chassis. If you must use the rack-optimized communication format with a remote 1756 chassis, put the 1756-EN2T and 1756-ENBT modules in a separate remote chassis.

### *Direct Connections For I/O Modules*

In this example, assume that each distributed I/O module is configured for a direct connection to the controller.




**Example - System Connections**

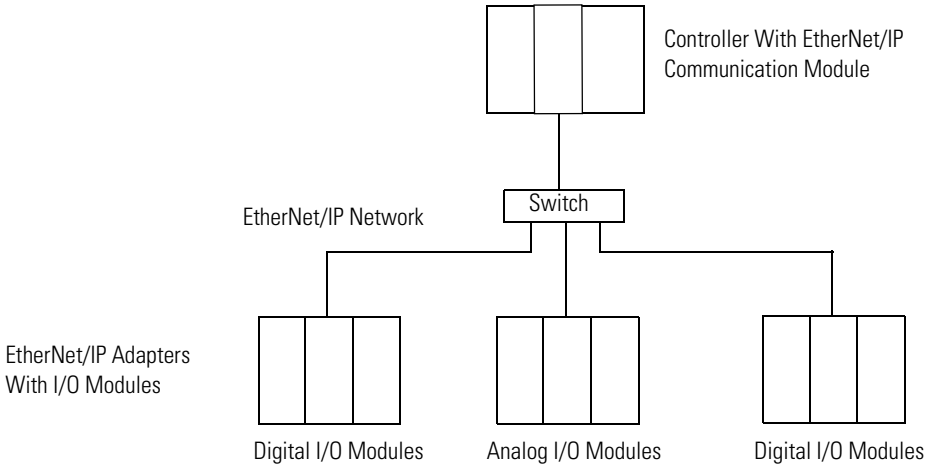
| System Connections | Amount |
|---|---|
| Controller to local EtherNet/IP communication module | 0 |
| Controller to EtherNet/IP adapter<br>Direct connection for digital I/O module | 4 |
| Direct connection for analog I/O module | 2 |
| Total connections used | 6 |

If you have many modules, direct connections to each module may not be feasible because you could use up the number of connections and packets per second supported by the module.

See Rack-optimized Connections For I/O Modules on page 85 to conserve connection use and network traffic.

### *Rack-optimized Connections For I/O Modules*

In this example, assume that each digital I/O module is configured for a rack-optimized connection to the controller. Analog modules must be configured for direct connections.




**Example - System Connections**

| System Connections | Amount |
|---|---|
| Controller to local EtherNet/IP communication module | 0 |
| Controller to EtherNet/IP adapter with digital modules (rack-optimized connection to each adapter) | 2 |
| Controller to EtherNet/IP adapter with analog modules (direct connection for each analog I/O module) | 2 |
| Total Connections used | 4 |

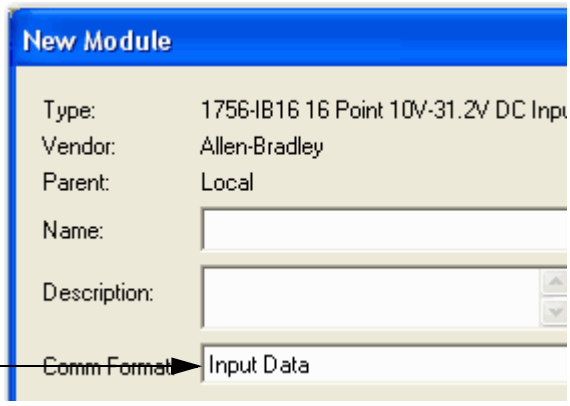
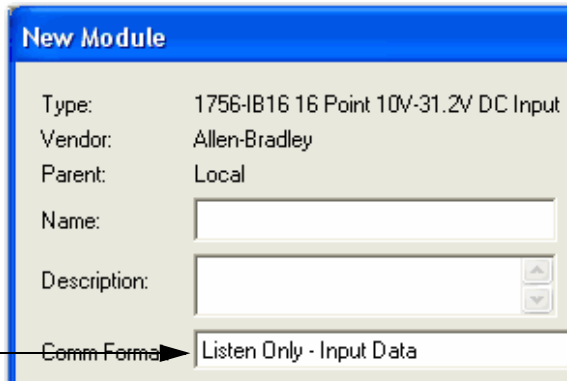
The rack-optimized connection conserves connections, but can limit the status and diagnostic information that is available from the I/O modules.

To optimize the number of available connections, use a rack-optimized connection between any digital I/O that allows it and the remote adapter that connects the distributed I/O to the controller via the communication module.

## Ownership

In a Logix5000 system, modules multicast data. Therefore, multiple modules can receive the same data at the same time from a single module. When choosing a communication format, decide whether to establish an owner-controller or listen-only relationship with the module.

**Types of Module Ownership**

| | |
|---|---|
| Owner controller | The controller that creates the primary configuration and communication connection to a module. The owner controller writes configuration data and can establish a connection to the module.<br>An owner connection is any connection that does not include Listen-Only in its Comm Format.<br>  |
| Listen-only connection | An I/O connection where another controller owns/provides the configuration data for the I/O module. A controller using a listen-only connection only monitors the module. It does not write configuration data and can only maintain a connection to the I/O module when the owner controller is actively controlling the I/O module.<br>Listen-only connection<br>  |

**Choosing a Type of Module Ownership**

| If the module is an | And another controller | And you want to | Then use this type of connection |
|---|---|---|---|
| Input module | Does not own the module | → | Owner |
| | Owns the module | Maintain communication with the module if it loses communication with the other controller | Owner<br>Use the same configuration as the other owner controller. |
| | | Stop communication with the module if it loses communication with the other controller | Listen-only |
| Output module | Does not own the module | → | Owner |
| | Owns the module | → | Listen-only |

**Input and Output Modules - Differences in Ownership**

| Control | This Ownership | Description |
|---|---|---|
| Input modules | Owner | An input module is configured by a controller that establishes a connection as an owner. This configuring controller is the first controller to establish an owner connection.<br><br>Once an input module has been configured and owned by a controller, other controllers can establish owner connections to that module. This allows additional owners to continue to receive multicast data if the original owner controller breaks its connection to the module. Additional owners must have the identical configuration data and communication format as the original owner controller; otherwise, the connection attempt is rejected. |
| | Listen-only | Once an input module has been configured and owned by a controller, other controllers can establish a listen-only connection to that module. These controllers can receive multicast data while another controller owns the module. If all owner controllers break their connections to the input module, all controllers with listen-only connections no longer receive multicast data. |
| Output modules | Owner | An output module is configured by a controller that establishes a connection as an owner. Only one owner connection is allowed for an output module. If another controller attempts to establish an owner connection, the connection attempt is rejected. |
| | Listen-only | Once an output module has been configured and owned by one controller, other controllers must establish listen-only connections to that module. These controllers can receive multicast data while another controller owns the module. If the owner controller breaks its connection to the output module, all controllers with listen-only connections no longer receive multicast data. |

## Select a Remote Adapter

**Choice of Remote Adapter**

| Type of Distributed I/O | Required Remote Adapters |
|---|---|
| 1756 ControlLogix I/O | 1756-ENBT, 1756-EN2T, or 1756-EN2TR |
| 1794 FLEX I/O | 1794-AENT |
| 1734 POINT I/O | 1734-AENT |

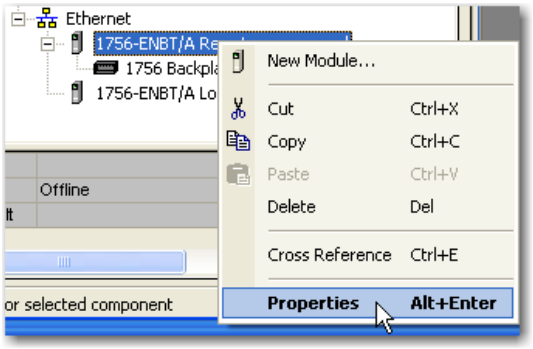
## Set the Requested Packet Interval (RPI)

When you configure an I/O module, you define the requested packet interval (RPI) rate for the module. Only data-producing modules require an RPI. For example, a local EtherNet/IP communication module requires no RPI because it produces no data for the system but acts only as a bridge.

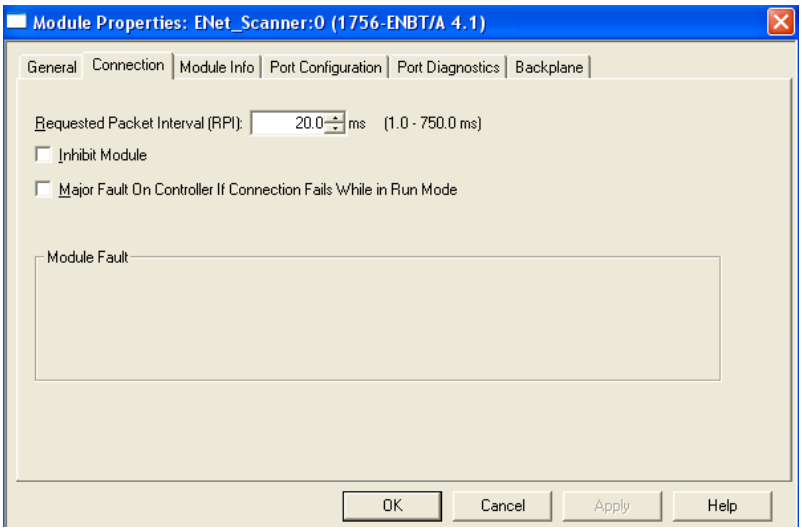
To set an RPI, perform this procedure.

1. Make sure the module is installed, started and connected to the controller via a serial, or other network, connection.

2. In the Controller Organizer of RSLogix 5000 programming software, right-click the EtherNet/IP module and choose Properties.




The Module Properties dialog box appears.




3. Click the Connection tab.

4. From the Requested Packet Interval (RPI) menu, select the rate at which you want data to be updated over a connection.

   Only set the RPI to the rate the application requires.

   **IMPORTANT** The RPI determines the number of packets per second that the module will produce on a connection. Each module can only produce a limited number of packets per second. Exceeding this limit prevents the module from opening more connections.

5. Click OK.

Unlike EtherNet/IP modules, in Logix5000 controllers, I/O values update at an interval set via the project's I/O configuration folder. The values update asynchronously to the execution of logic. At the specified interval, the controller updates a value independently from the execution of logic.

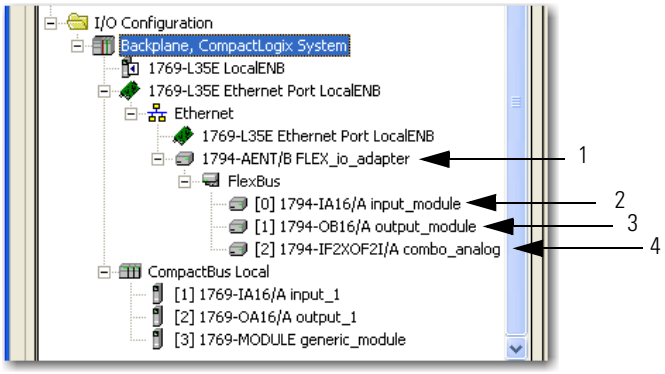
## Access Distributed I/O

I/O information is presented as a structure of multiple fields, which depends on the specific features of the I/O module. The name of the structure is based on the location of the I/O module in the system. Each I/O tag is automatically created when you configure the I/O module through the programming software. Each tag name follows this format:

Location:SlotNumber:Type.MemberName.SubMemberName.Bit

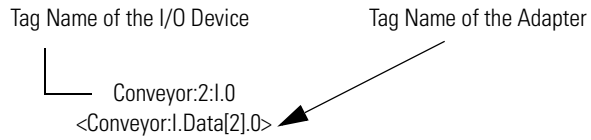
| This address variable | Is |
|---|---|
| Location | Identifies network location<br>LOCAL = local DIN rail or chassis<br>ADAPTER_NAME = identifies remote adapter or bridge |
| SlotNumber | Slot number of I/O module in its chassis |
| Type | Type of data<br>I = input<br>O = output<br>C = configuration<br>S = status |
| MemberName | Specific data from the I/O module, which depends on the type of data the module can store<br>For example, Data and Fault are possible fields of data for an I/O module. Data is the common name for values the are sent to or received from I/O points. |
| SubMemberName | Specific data related to a MemberName |
| Bit (optional) | Specific point on the I/O module, which depends on the size of the I/O module (0...31 for a 32-point module) |

**EXAMPLE**




| Example | Module | Example Tag Names (automatically created by the software) |
|---|---|---|
| 1 | Remote 1794-AENT adapter<br>“FLEX_io_adapter” | FLEX_io_adapter:I<br>FLEX_io_adapter:I.SlotStatusBits<br>FLEX_io_adapter:I.Data<br>FLEX_io_adapter:O<br>FLEX_io_adapter:O.Data |
| 2 | Remote 1794-IA16<br>“input_module” in slot 0<br>Rack-optimized connection | FLEX_io_adapter:0:C<br>FLEX_io_adapter:0:C.Config<br>FLEX_io_adapter:0:C.DelayTime_0<br>FLEX_io_adapter:0:C.DelayTime_1<br>FLEX_io_adapter:0:C.DelayTime_2<br>FLEX_io_adapter:0:C.DelayTime_3<br>FLEX_io_adapter:0:C.DelayTime_4<br>FLEX_io_adapter:0:C.DelayTime_5<br>FLEX_io_adapter:0:I |
| 3 | Remote 1794-OB16<br>“output_module” in slot 1<br>Rack-optimized connection | FLEX_io_adapter:1:C<br>FLEX_io_adapter:1:C.SSData<br>FLEX_io_adapter:1:O<br>FLEX_io_adapter:1:O.Data |
| 4 | Remote 1794-IF2XOF2I<br>“combo_analog” in slot 2<br>Direct connection | FLEX_io_adapter:2:C<br>FLEX_io_adapter:2:C.InputFIlter<br>FLEX_io_adapter:2:C.InputConfiguration<br>FLEX_io_adapter:2:C.OutputConfiguration<br>FLEX_io_adapter:2:C.RTSInterval<br>FLEX_io_adapter:2:C.SSCh0OuputData<br>FLEX_io_adapter:2:C.SSCH1OutputData<br>FLEX_io_adapter:2:I |

The choice of rack optimization for an I/O module creates tags as aliases for the adapter module's tags. This logic displays the device's tag as an alias for a the adapter module's tag. In this example, the tag name of the adapter is in angle brackets.




## Additional Resources

This document contains additional information on controlling I/O:

EtherNet/IP Performance Application Solution, publication ENET-AP001.

# Interlocking and Data Transfer Between Controllers

## Introduction

This chapter describes how to share data by interlocking controllers (producing and consuming tags) and transferring messages between controllers via an EtherNet/IP network.

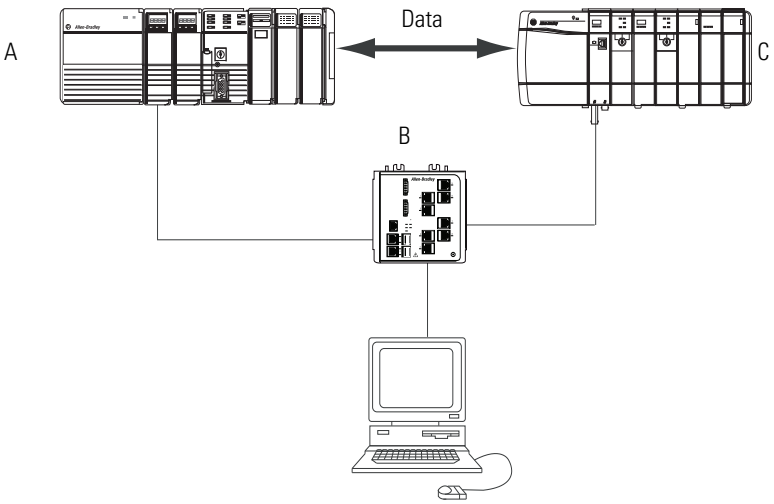
**Communciation Methods**

| If you want to | And the data | Then | Page |
|---|---|---|---|
| Interlock operations | Resides on Logix5000 controllers | Produce and consume a tag | 95 |
| Transfer data | Needs regular delivery at an interval that you specify | Produce and consume a tag | 95 |
| | Is sent when a specific condition occurs in your application | Execute a message (MSG) instruction | 105 |

## Set Up the Hardware

In this example, the controller in the local chassis produces a tag that the Logix5000 controller in the remote chassis consumes. The local controller can also send a MSG instruction to the remote controller.

**Sharing Data and Transferring Messages**




| Item | Description |
|---|---|
| A | Local chassis containing a Logix5000 Controller with EtherNet/IP Communication Module |
| B | Switch |
| C | Remote chassis containing a Logix5000 Controller with EtherNet/IP Communication Module |

## Logix5000 Controller Combinations

**Choosing a Communication Module**

| Controllers | Communication Modules |
|---|---|
| 1756 ControlLogix | 1756-ENBT, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, or 1756-EN2F communication module |
| 1768 CompactLogix | 1768-ENBT communication module |
| 1769-L23E-QB1B, 1769-L23E-QBFC1B, 1769-L32E and 1769-L35E CompactLogix | A built-in EtherNet/IP port |
| 1794 FlexLogix | 1788-ENBT EtherNet/IP communication card |
| PowerFlex 700S with DriveLogix controller | 1788-ENBT EtherNet/IP communication card |

Make sure to:

- set the IP addresses and other network parameters for each EtherNet/IP communication module.
- connect all wiring and cabling.
- configure the communication driver (such as AB-ETHIP-1) for the programming workstation

**IMPORTANT** If you are sharing tags between ControlLogix controllers and the controllers are sharing only tags, not sending messages, set the communication format of the 1756-ENBT, 1756-EN2F, 1756-EN2T, or 1756-EN2TXT module to None.

## Tag Guidelines for Produced or Consumed Data

To properly organize tags for produced or consumed data (shared data), follow these guidelines.

**Guidelines for the Organization of Tags**

| Guideline | Details |
|---|---|
| Create the tags at the controller scope. | You can share only controller-scoped tags. |
| Use one of these data types:<br>· DINT<br>· REAL<br>· array of DINTs or REALs<br>· user-defined | • To share other data types, create a user-defined data type that contains the required data.<br>• Use the same data type for the produced tag and corresponding consumed tag or tags. |
| Limit the size of the tag to ≤500 bytes. | If transferring more than 500 bytes, create logic to transfer the data in packets.<br>A size of < 125 DINT words will keep total bytes within 500. This helps reduce the total number of packets for transactions. |
| Combine data that goes to the same controller. | If producing several tags for the same controller:<br>• Group the data into one or more user-defined data types. This method uses fewer connections than does producing each tag separately.<br>• Group the data according to similar update intervals. To conserve network bandwidth, use a greater RPI for less critical data.<br>For example, you could create one tag for data that is critical and another tag for data that is not as critical. |

## Terminology

A Logix5000 controller can produce (broadcast) and consume (receive) system-shared tags.

**Tag Definitions**

| Term | Definition |
|---|---|
| Produced tag | A tag that a controller makes available for use by other controllers. Multiple controllers can simultaneously consume (receive) the data. A produced tag sends its data to one or more consumed tags (consumers) without using logic. The produced tag sends its data at the RPI of the consuming tag. |
| Consumed tag | A tag that receives the data of a produced tag. The data type of the consumed tag must match the data type (including any array dimensions) of the produced tag. The RPI of the consumed tag determines the period at which the data updates. |

To share produced or consumed tags, two controllers must be attached to the same EtherNet/IP subnet. Two controllers cannot bridge produced or consumed tags over two subnets.

## Connections for Produced and Consumed Tags

Logix controllers can produce (broadcast) and consume (receive) system-shared tags that are sent and received via the EtherNet/IP communication module. Produced and consumed tags each require connections.

**Required Connections for Produced and Consumed Tags**

| Tag Type | Required Connections |
|---|---|
| Produced | The local controller (producing) must have one connection for the produced tag and the first consumer and one more connection for each additional consumer (heartbeat). The produced tag requires two connections.<br><br>As you increase the number of controllers that can consume a produced tag, you also reduce the number of connections the controller has available for other operations, such as communication and I/O. |
| Consumed | Each consumed tag requires one connection for the controller that is consuming the tag. |

All EtherNet/IP modules support as many as 32 produced multicast connections. Because each tag that passes through an EtherNet/IP module uses a single connection, the number of available connections limits the total number of tags that can be produced or consumed. If the communication module uses all of its connections for I/O and other communication modules, no connections remain for produced and consumed tags.

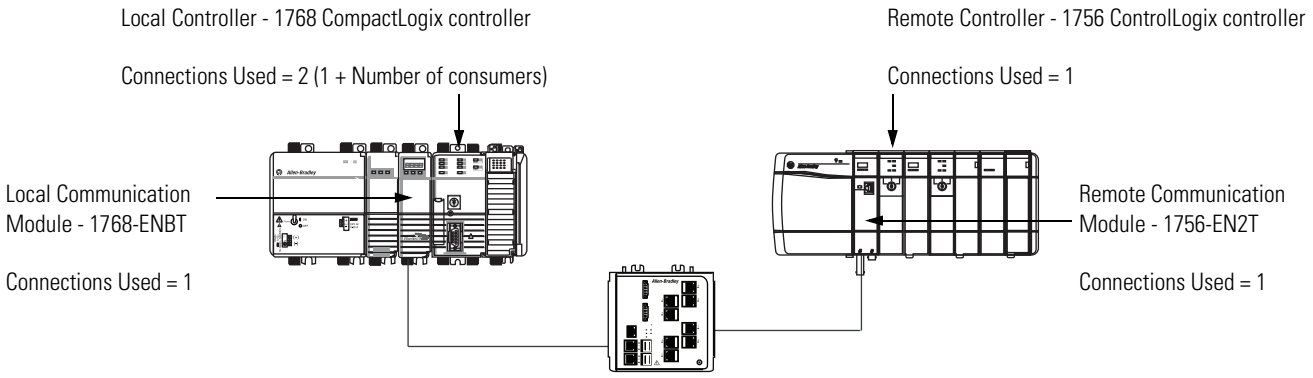
**IMPORTANT** Depending on whether it is producing or consuming a tag, a Logix5000 controller uses its connections differently.

**Number Connections for Produced and Consumed Tags**

| Type of Tag | Device | Number of Connections Used |
|---|---|---|
| Produced tag | Logix5000 controller | Number_of_consumers + 1 |
| | EtherNet/IP module | 1 |
| Consumed tag | Logix5000 controller | 1 |
| | EtherNet/IP module | |

The graphic below shows a Logix5000 controller producing a single tag for consumption by another Logix5000 controller. In this example, the producing controller uses 2 connections and every other Logix module/controller uses only 1 connection.

**Logix5000 Controllerin Local Chassis Producing a Single Tag for a Logix5000 Controller in a Remote Chassis**


Local Controller - 1768 CompactLogix controller
Connections Used = 2 (1 + Number of consumers)
Remote Controller - 1756 ControlLogix controller
Connections Used = 1
Local Communication Module - 1768-ENBT
Connections Used = 1
Remote Communication Module - 1756-EN2T
Connections Used = 1

At its limits, a Logix5000 controller that produced 125 tags, each with only 1 consumer, the controller would use all of its available 250 connections. In this example, the EtherNet modules used to communicate the tags would only use 125 connections. An example of the different

TCP and CIP connection capacities vary for all EtherNet/IP modules.

| Module | Packets/Second | TCP Connections | CIP Connections |
|---|---|---|---|
| 1756-ENBT | 5000 | 64 | 128 |
| 1756-EN2F | 10,000 | 128 | 256 |
| 1756-EN2T | 10,000 | 128 | 256 |
| 1756-EN2TR | 10,000 | 128 | 256 |
| 1756-EN2TXT | 10,000 | 128 | 256 |
| 1768-ENBT | 5000 | 32 | 64 |
| 1769-L23E-QB1B, 1769-L23E-QBFC1B | 2000 | 8 | 32 |
| 1769-L32E | 4000 | 64 | 32 |
| 1769-L35E | 4000 | 64 | 32 |
| 1788-ENBT | 4000 | 64 | 32 |
| 1794-AENT | 9500 | 64 | 64 |
| 2x-COMM-E | 400 | 30 | 16 |
| 1734-AENT | 5000 | 64 | 20 |

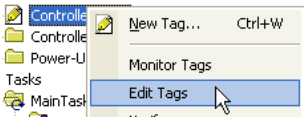
# Produce a Tag

To produce a tag, configure the produced tag in the RSLogix 5000 project for the local (producer) controller. You do not have to configure the consumer controllers in the I/O Configuration folder of the producer controller.

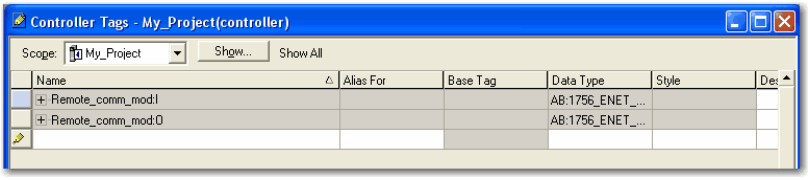
## Configure the Produced Tag

To configure the produced tag, perform this procedure.

1. In the producer's controller organizer in RSLogix 5000 programming software, right-click the Controller Tags folder and select Edit Tags.

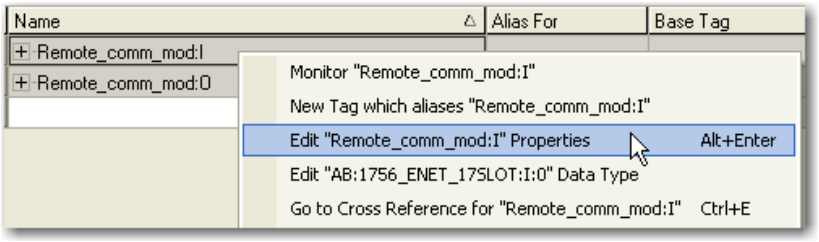



   The Controller Tags dialog box appears.

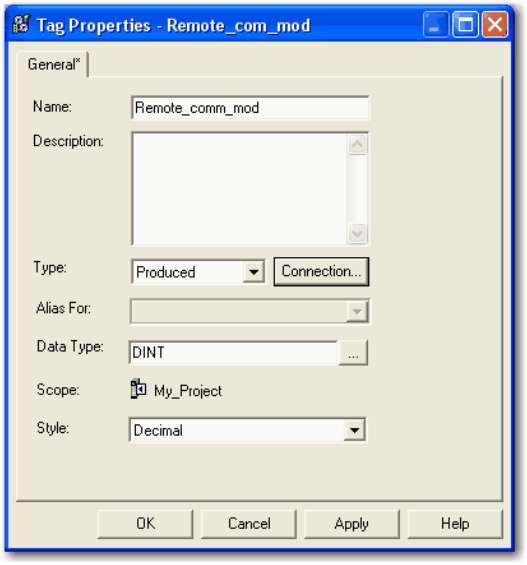



   You can produce only controller-scoped tags.

2. In the Controller Tags window, right-click the tag that you want to produce and choose Edit Tag Properties.



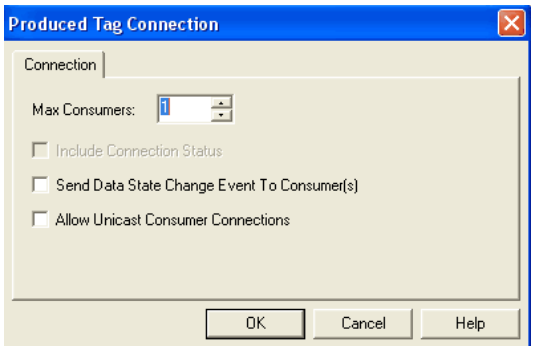
The Tag Properties dialog box appears.




3. From the Type pull-down menu, select Produced.

4. Click Connection.

The Produced Tag Connection dialog box appears.




5. In the Max Consumers field, type the maximum number of controllers that will consume (receive) the tag.

6. Click OK.

# Consume Data Produced by Another Controller

To consume a produced tag, specify both the producer controller and the produced tag in the RSLogix 5000 project for the remote (consumer) Logix5000 controller.

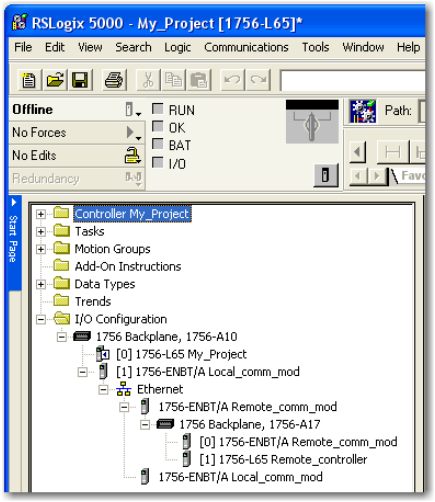
## Add the Producer Controller to the Consumer's I/O Configuration

Add the producer controller to the remote controller's I/O Configuration folder. In the folder, organize the controllers and communication modules into a hierarchy of tree/branch and parent/child.

For the addition of a Producer controller, such as shown below,

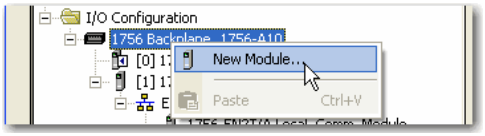
you build the I/O configuration with the following steps.

1. Add the local communication module for the consumer controller.
2. Add the remote communication module for the producer controller.
3. Add the producer controller.

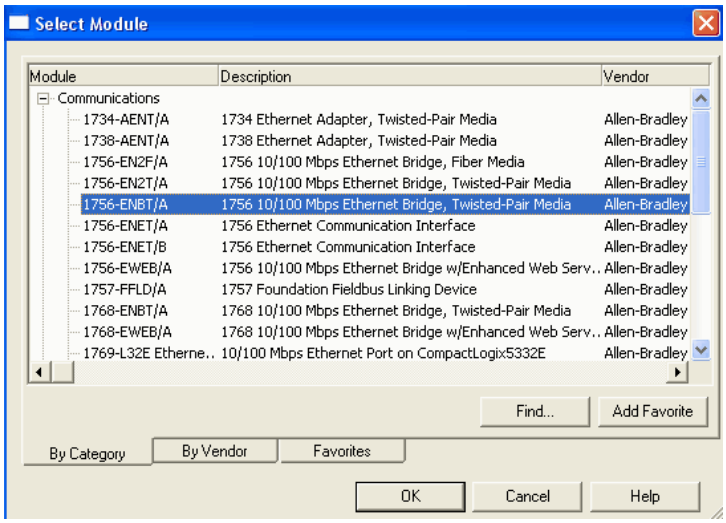


To add a module to the I/O Configuration folder, perform this procedure.

1. In RSLogix 5000 programming software, right-click the level to which you want to add the new module and choose New Module.



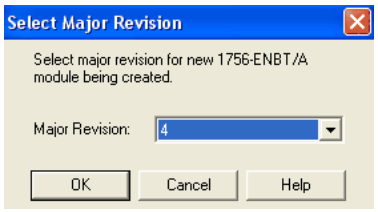

The Select Module Type dialog box appears.




2. Click the By Category tab and browse for your EtherNet/IP communication module.

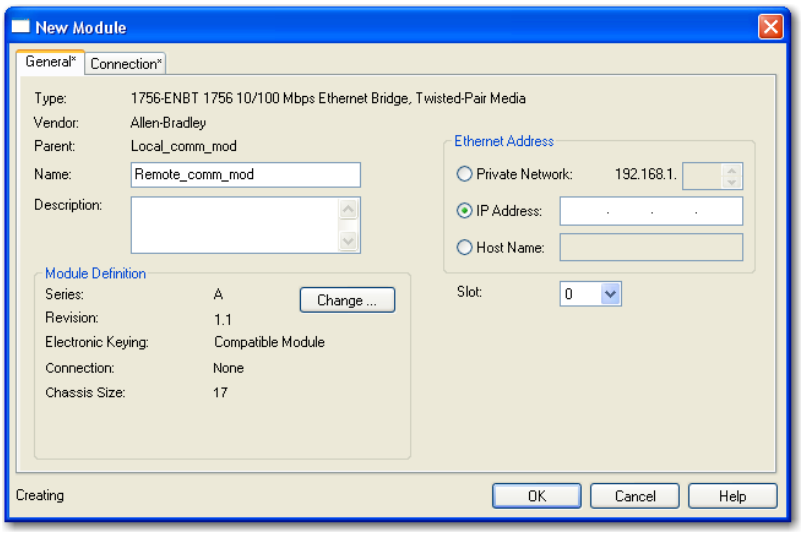
3. Click OK.

The Select Major Revision dialog box appears.




4. From the Major Revision pull-down menu, choose the correct revision and click OK.

The New Module dialog box appears.




5. Configure your new module.
   a. In the Name field, type the name of your module.
   b. From the Comm Format pull-down menu, select a communication format.

**IMPORTANT** When consuming a tag, select None as the Communication Format.

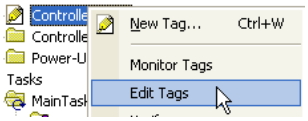
   c. In the Slot field, type the chassis slot number.
   d. In the Chassis Size field, type the chassis size.
   e. From the Revision pull-down menu, select a revision number.
   f. In the IP Address field, type the module IP address.
   g. From the Electronic Keying pull-down menu, select Disable Keying.

6. Click OK.

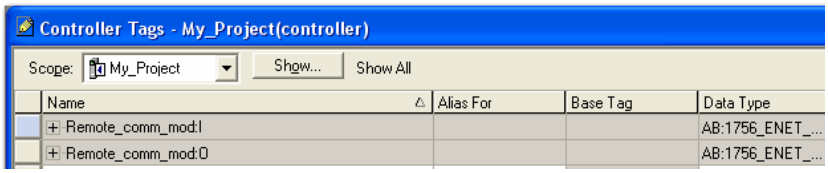
## Create the Consumed Tag

To create the consumed tag, perform this procedure.

1. In the consumer controller's project in RSLogix 5000 programming software, right-click the Controller Tags folder and choose Edit Tags.

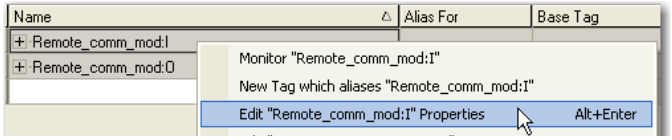



   The Controllers Tag dialog box appears.

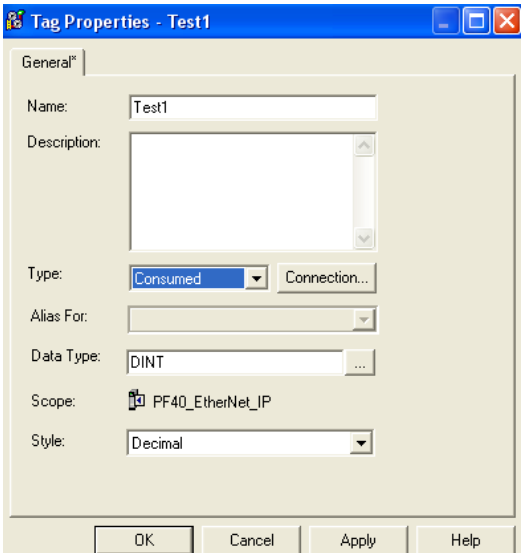



   Only controller-scoped tags can consume data.

2. In the Controller Tags window, right-click the tag that will consume the data and choose Edit Tag Properties.




   The Tag Properties dialog box appears.

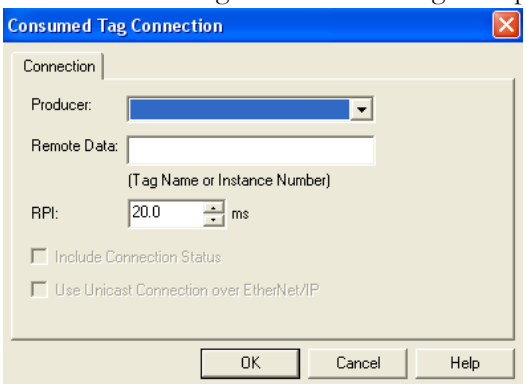



3. From the Type pull-down menu, choose Consumed.

4. In the Data Type field, enter a data type that matches the type assigned to the produced tag.

5. Click Connection.

   The Consumed Tag Connection dialog box appears.




6. From the Producer pull-down menu, choose the controller that produces the data.

7. In the Remote Data field, type the tag name or instance number of the produced data.

8. In the RPI field, type the requested packet interval (RPI) for the connection.

   Only set the RPI to the rate the application requires.

**IMPORTANT** The RPI determines the number of packets per second that the module will produce on a connection. Each module can only produce a limited number of packets per second. Exceeding this limit prevents the module from opening more connections.

   For information on RPI and how it affects the actual packet interval (API), see the EtherNet/IP Performance Application Solution, publication ENET-AP001.

9. Click OK.

# Guidelines for Message (MSG) Instructions

Follow these guidelines.

### MSG Instruction Guidelines

| Guideline | Details |
|---|---|
| For each MSG instruction, create a control tag. | Each MSG instruction requires its own control tag.<br>· Data type = MESSAGE<br>· Scope = controller<br>· The tag cannot be part of an array or a user-defined data type. |
| Keep the source and destination data at the controller scope. | A MSG instruction can access only tags that are in the Controller Tags folder. |
| If your MSG is to a module that uses 16-bit integers, use a buffer of INTs in the MSG and DINTs throughout the project. | If your message is to a module that uses 16-bit integers, such as a PLC-5 or SLC 500 controller, and it transfers integers (not REALs), use a buffer of INTs in the message and DINTs throughout the project.<br>This increases the efficiency of your project because Logix5000 controllers execute more efficiently and use less memory when working with 32-bit integers (DINTs). |
| Cache the connected MSGs that execute most frequently. | Cache the connection for those MSG instructions that execute most frequently, up to the maximum number permissible for your controller revision.<br>This optimizes execution time because the controller does not have to open a connection each time the message executes. |
| If you want to enable more than 16 MSGs at one time, use some type of management strategy. | If you enable more than 16 MSGs at one time, some MSG instructions may experience delays in entering the queue. To guarantee the execution of each message, either:<br>· enable each message in sequence.<br>· enable the messages in groups.<br>· program a message to communicate with multiple modules.<br>· program logic to coordinate the execution of messages. |
| Keep the number of unconnected and uncached MSGs less than the number of unconnected buffers. | The controller can have 10...40 unconnected buffers. The default number is 10.<br>· If all the unconnected buffers are in use when an instruction leaves the message queue, the instruction errors and does not transfer the data.<br>· You can increase the number of unconnected buffers to a maximum of 40. |

For more information on programming MSG instructions, see the Logix5000 Controller General Instructions Reference Manual, publication 1756-RM003.

The individual system user manuals for Logix5000 controllers also provide MSG examples unique to specific controller platforms.

## Connections for Messages

Messages transfer data to other modules, such as other controllers or operator interfaces. Each message uses one connection, regardless of how many modules are in the message path. To conserve connections, you can configure one message to read from or write to multiple modules.

These connected messages can leave the connection open (cache) or close the connection when the message is done transmitting.

**Message Connections**

| Type of Message | Communication Method Used | Connection Used |
|---|---|---|
| CIP data table read or write | CIP | Yes |
| PLC2, PLC3, PLC5, or SLC (all types) | CIP | No |
| | CIP with Source ID | No |
| | DH+ | Yes |
| CIP generic | CIP | Your choice(1) |
| Block-transfer read or write | | Yes |

(1) You can connect CIP generic messages, but for most applications we recommend you leave CIP generic messages unconnected.

## Cache Message Connections

**Guidelines for Caching Message Connections**

| Message Execution | Instruction |
|---|---|
| Repeated | Cache the connection.<br><br>**Important:** Caching keeps the connection open and optimizes execution time. Opening a connection each time the message executes increases execution time. |
| Infrequent | Do not cache the connection.<br><br>**Important:** Not caching closes the connection upon completion of the message, freeing up the connection for other uses. |

## Enter Message Logic

To send or receive data from an EtherNet/IP module via a message, you must program a MSG instruction in the local controller's logic. If the target module is configured in the I/O Configuration folder of the controller, browse to select the module or manually enter the message path in the MSG instruction.

### Add the EtherNet/IP Module to the Local Controller's I/O Configuration

**IMPORTANT** The number of TCP and CIP connections supported by the 1768-ENBT module depends on the firmware revision you are using. If you are using firmware revision 1.*x*, the module supports 32 TCP connections and 64 CIP connections. If you are using firmware revision 2.*x* or later, the module supports 64 TCP connections and 128 CIP connections.

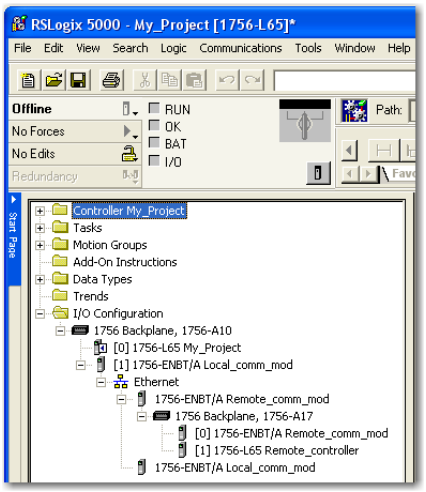
To use the Browse button to select the target device of a MSG instruction, add that remote device to the I/O Configuration folder of the local controller. Within the I/O Configuration folder, organize the local and remote devices into a hierarchy of tree/branch, parent/child.

For a typical local/remote MSG structure, such as the one shown below,

you build the I/O configuration with the following steps.

1. Add the local communication module for the local controller.
2. Add the remote communication module for the remote controller.

3. Add the remote controller.



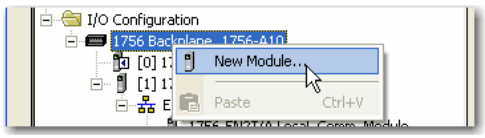

Select a communication format for a communication module based on the modules in its remote chassis.

### Module Communication Formats

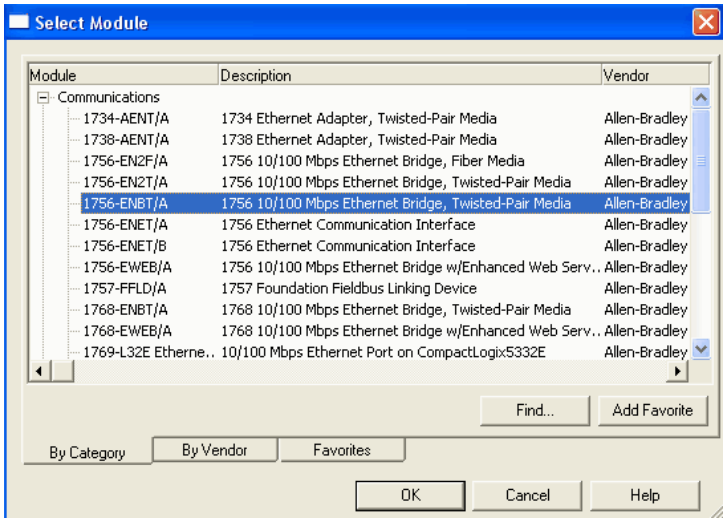
| If | Select a communication format that specifies |
|---|---|
| The remote chassis contains only analog modules, diagnostic digital modules, fused output modules, or communication modules | None |
| The remote chassis only contains standard, digital input and output modules (no diagnostic modules or fused output modules) | Rack Optimization |
| You want to receive I/O module and chassis slot information from a rack-optimized remote chassis owned by another controller | Listen-Only Rack Optimization |

To add a module to the I/O Configuration folder, perform this procedure.

1. In RSLogix 5000 programming software, right-click the level to which you want to add the new module and choose New Module.



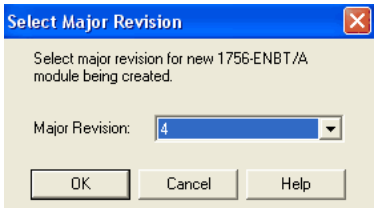
The Select Module Type dialog box appears.




2. Click the By Category tab and browse for your EtherNet/IP communication module.

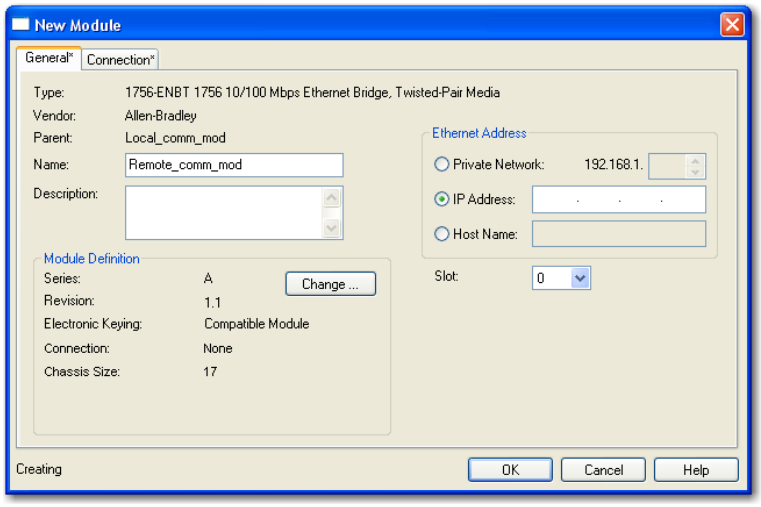
3. Click OK.

The Select Major Revision dialog box appears.




4. From the Major Revision pull-down menu, choose the correct revision and click OK.

The New Module dialog box appears.



5. Configure your new module.
   a. In the Name field, type the name of your module.
   b. From the Comm Format pull-down menu, select a communication format.
   c. In the Slot field, type the chassis slot number.
   d. In the Chassis Size field, type the chassis size.
   e. From the Revision pull-down menu, select a revision number.
   f. In the IP Address field, type the module IP address.
   g. From the Electronic Keying pull-down menu, select Compatible Module.
6. Click OK.

## Enter a Message

To enter a message, perform this procedure.

1. Use relay ladder logic to enter a MSG instruction.
2. Click the button ... to configure the MSG instruction.

**EXAMPLE** Enter a MSG instruction

If *count_send* = 1 and *count_msg.EN* = 0 (MSG instruction is not already enabled), then execute a MSG instruction that sends data to another controller.

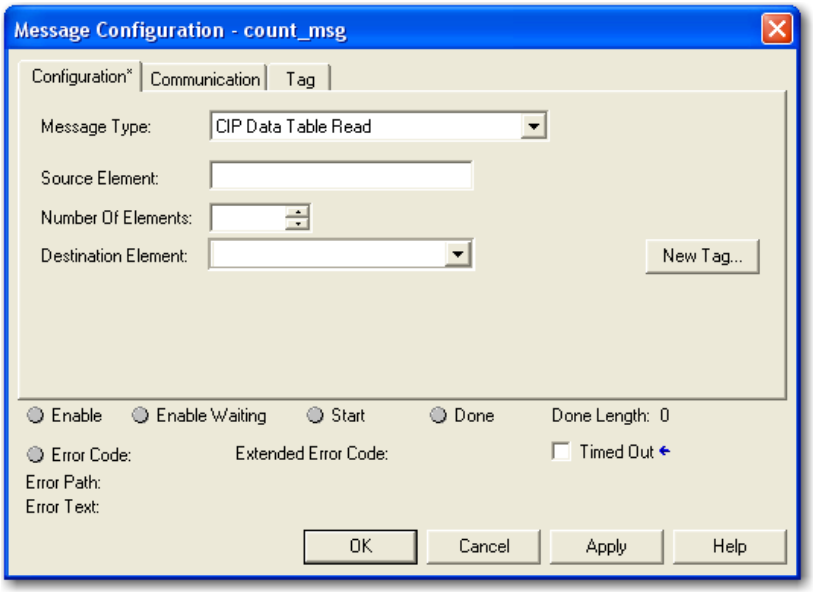
## Configure a MSG Instruction

To configure a MSG instruction, perform this procedure.

1. Click ... in the MSG box.

   The Message Configuration dialog box appears.

2. Click the Configuration tab and specify the type of MSG instruction.




*Configure a MSG to a Logix5000 Controller*

| If you want to | For this item | Type or select |
|---|---|---|
| Read (receive) the data | Message Type | CIP Data Table Read |
| | Source Element | First element of the tag that contains data in the other controller |
| | Number of Elements | Number of elements to transfer |
| | Destination Tag | First element of the tag (controller-scoped) in this controller for the data |
| Write (send) the data | Message Type | CIP Data Table Write |
| | Source Tag | First element of the tag (controller-scoped) in this controller that contains the data |
| | Number of Elements | Number of elements to transfer |
| | Destination Element | First element of the tag for the data in the other controller |

*Configure a MSG to an SLC 500 Processor*

| If the data is | And you want to | For this item | Type or select |
|---|---|---|---|
| Integer | Read (receive) data | Message Type | SLC Typed Read |
| | | Source Element | Data table address in the SLC 500 controller (for example, N7:10) |
| | | Number of Elements | Number of integers to transfer |
| | | Destination Tag | First element of int_buffer |
| | Write (send) data | Message Type | SLC Typed Write |
| | | Source Tag | First Element of int_buffer |
| | | Number of Elements | Number of integers to transfer |
| | | Destination Element | Data table address in the SLC 500 controller (for example, N7:10) |
| Floating-point (REAL) | Read (receive) data | Message Type | SLC Typed Read |
| | | Source Element | Data table address in the SLC 500 controller (for example, F8:0) |
| | | Number of Elements | Number of values to transfer |
| | | Destination Tag | First element of the tag (controller-scoped) in this controller for the data |
| | Write (send) data | Message Type | SLC Typed Write |
| | | Source Tag | First element of the tag (controller-scoped) in this controller that contains the data |
| | | Number of Elements | Number of values to transfer |
| | | Destination Element | Data table address in the SLC 500 controller (for example, F8:0) |

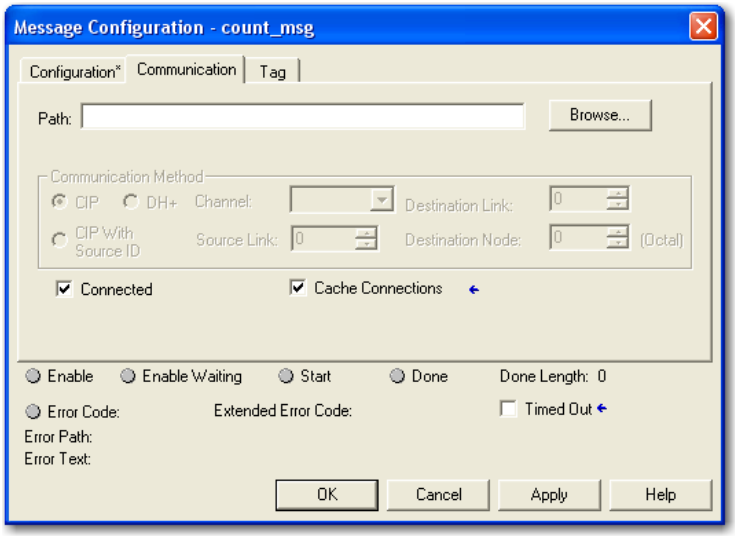
*Configure a MSG to a PLC-5 Processor*

| If the data is | And you want to | For this item | Type or select |
|---|---|---|---|
| Integer | Read (receive) data | Message Type | PLC5 Typed Read |
| | | Source Element | Data table address in the PLC-5 controller (for example, N7:10) |
| | | Number of Elements | Number of integers to transfer |
| | | Destination Tag | First element of int_buffer |
| | Write (send) data | Message Type | PLC5 Typed Write |
| | | Source Tag | First element of int_buffer |
| | | Number of Elements | Number of integers to transfer |
| | | Destination Element | Data Table address in the PLC-5 controller (for example, N7:10) |
| Floating-point (REAL) | Read (receive) data | Message Type | PLC5 Typed Read |
| | | Source Element | Data table address in the PLC-5 controller (for example, F8:0) |
| | | Number of Elements | Number of values to transfer |
| | | Destination Tag | First element of the tag (controller-scoped) in this controller for the data |
| | Write (send) data | Message Type | PLC5 Typed Write |
| | | Source Tag | First element of the tag (controller-scoped) in this controller that contains the data |
| | | Number of Elements | Number of values to transfer |
| | | Destination Element | Data table address in the PLC-5 controller (for example, F8:0) |

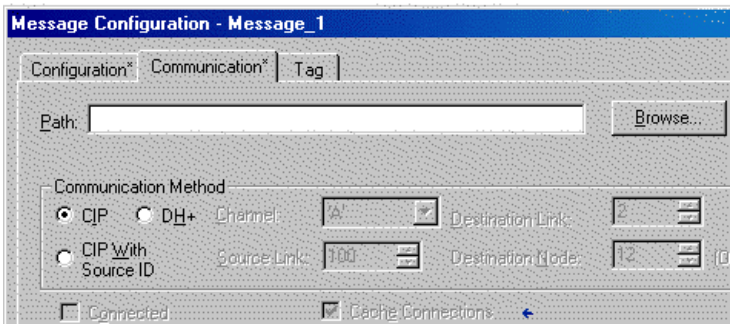
3. Click the Communication tab.

4. In the Path field, type the communication path.

   For a message to a ControlLogix controller, this RSLogix Message Configuration dialog box appears.



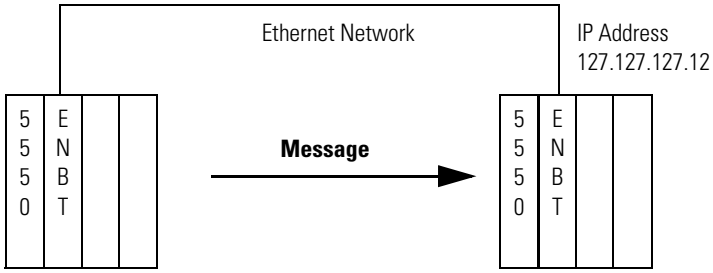
For a message to a SLC 500 or PLC-5 processor, this RSLogix Message Configuration dialog box appears.




5. If the target module is configured in the I/O Configuration folder of the originating controller, click Browse to select the module or manually enter the path to the target module.

   A manually entered path begins with the name of the local EtherNet/IP module, the port the message exits (2 for EtherNet/IP), and the IP address of the next module in the path, which could be the target module.

**EXAMPLE** Communication path from a Logix5000 controller to a Logix5000 controller over an EtherNet/IP network




washer, 2, 127.127.127.12, 1, 0

| Where | Indicates |
|---|---|
| Washer | Name of the 1756-ENBT, 1756-EN2T, or 1756-EN2F module |
| 2 | Ethernet port of the 1756-ENBT, 1756-EN2T, or EN2F module |
| 127.127.127.12 | IP address of the 1756-ENBT, 1756-EN2T, or 1756-EN2F module in the destination chassis |
| 1 | Backplane port of the 1756-ENBT, 1756-EN2T, or 1756-EN2F module in the destination chassis |
| 0 | Slot number of the destination controller |

## Communicate with PLC-5 or SLC Processors

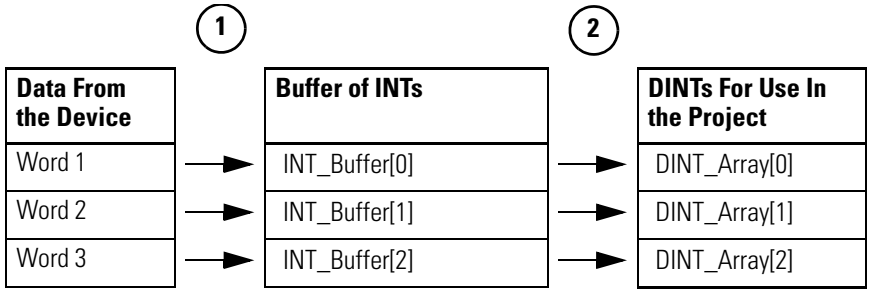
If the message is to a PLC-5 or SLC 500 processor and it reads or writes integers (not REALs), use a buffer of INTs in the message. Remember that:

- Logix5000 controllers execute more efficiently and use less memory when working with 32-bit integers (DINTs).
- PLC-5 and SLC 500 processors require 16-bit integers.
- Messages require an INT buffer.
- Data can be moved into or out of the buffer as needed.

### Converting between INTs and DINTs

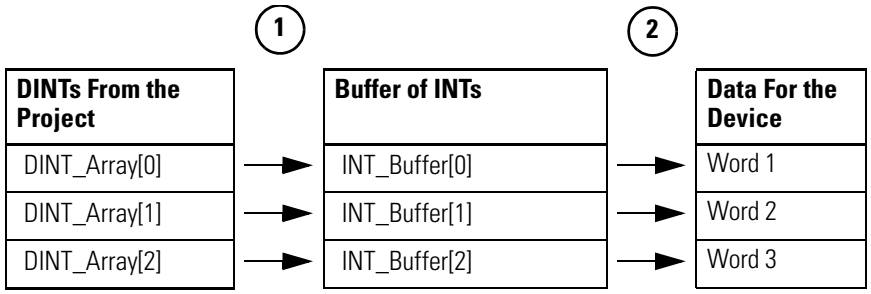
If the message is to a device that uses 16-bit integers, such as a PLC-5 or SLC 500 controller, and it transfers integers (not REALs), use a buffer of INTs in the message and DINTs throughout the project. This increases the efficiency of your project.

**Read 16-Bit Integers**




1. The Message (MSG) instruction reads 16-bit integers (INTs) from the device and stores them in a temporary array of INTs.
2. An File Arith/Logical (FAL) instruction converts the INTs to DINTs for use by other instructions in your project.

**Write 16-Bit Integers**

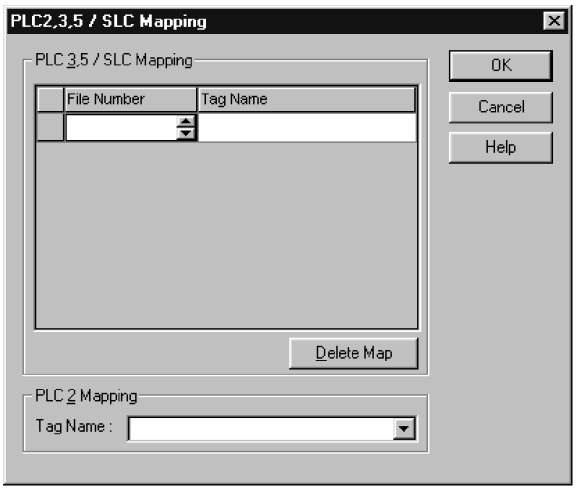



1. An FAL instruction converts the DINTs from the Logix5000 controller to INTs.
2. The MSG instruction writes the INTs from the temporary array to the device.

## Mapping Tags

A Logix5000 controller stores tag names on the controller so that other devices can read or write data without having to know physical memory locations. Many products only understand PLC/SLC data tables, so the Logix5000 controller offers a PLC/SLC mapping function that enables you to map Logix tag names to memory locations.

- You have to map only the file numbers that are used in messages; the other file numbers do not need to be mapped.
- The mapping table is loaded into the controller and is used whenever a logical address accesses data.
- You can access only controller-scoped tags (global data).




- For each file that is referenced in a PLC-5 or SLC command, make a map entry by:
  - typing the PLC/SLC file number of the logical address.
  - typing or selecting the Logix5000 controller-scoped (global) tag that supplies or receives data for the file number. (You can map multiple files to the same tag.)
- For PLC-2 commands, specify the tag that supplies or receives the data.

When mapping tags:

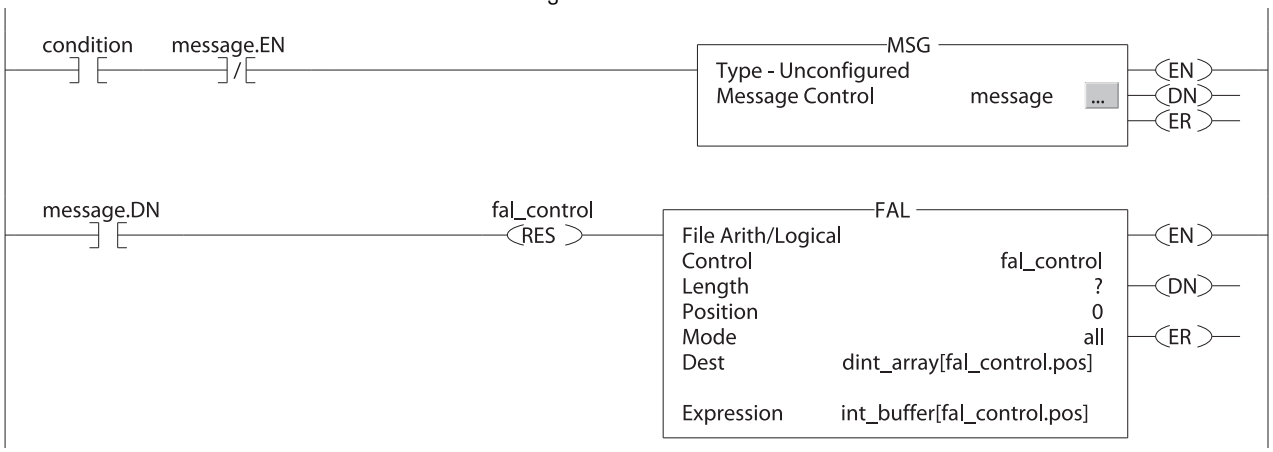
- do not use file numbers 0, 1, and 2. These files are reserved for Output, Input, and Status files in a PLC-5 processor.
- use PLC-5 mapping only for tag arrays of data type INT, DINT, or REAL. Attempting to map elements of system structures may produce undesirable effects.
- use the PLC file identifier of N or B when accessing elements in an INT tag array.

This example shows how to use a buffer of INTs.

**EXAMPLE**

Read integers from a PLC-5 controller.

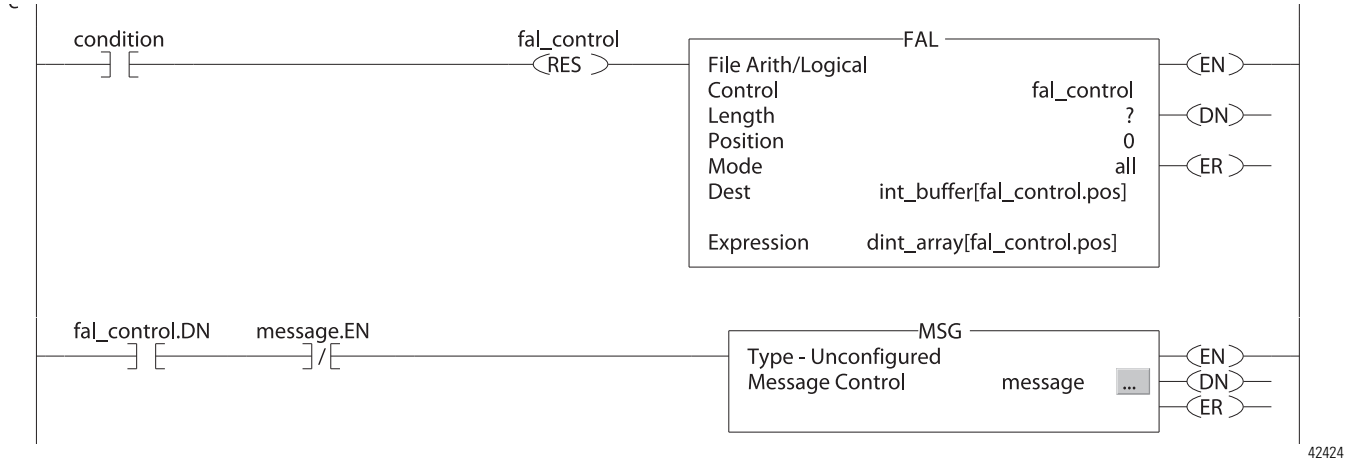
When condition turns on, reads 16-bit integer values (INTs) and stores them in int_buffer. Then the FAL instruction moves the values to dint_array. This converts the values to 32-bit integers (DINTs), for use by other instructions in the ControlLogix controller.




**EXAMPLE**

Write integers to a PLC-5 controller.

When *c*ondition turns on, moves the values in dint_array to int_buffer. This converts the values to 16-bit integers (INTs). Then the message instruction sends int_buffer to the other controller.

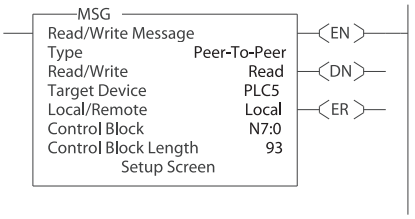



| Where | Is an |
|---|---|
| dint_array | Array of DINTs that are used in the ControlLogix controller |
| int_buffer | Array of INTs with the same number of elements as dint_array |

## Receive MSGs from PLC-5 or SLC 500 Processors

To receive MSGs from PLC-5 or SLC 500 processors,

1. If the originating controller is a PLC-5 or SLC 500 processor, in the MSG instruction, select PLC5.




| If the controller is a | For this section | And this item | Specify |
|---|---|---|---|
| PLC-5 | This PLC-5 | Communication Command | PLC-5 Typed Read or PLC-5 Typed Write |
| | | Data Table Address | Starting address of the data in the PLC-5 controller |
| | | Size in Elements | Number of elements to read or write |
| | | Port Number | 2 |
| | Target Device | Data Table Address | Type, in quotation marks [" "], the name of the tag in the ControlLogix controller (for example, "count"). |
| | | MultiHop | Select Yes. |
| SLC 500 | This Controller | Communication Command | PLC5 Read or PLC5 Write |
| | | Data Table Address | Starting address of the data in the SLC 500 controller |
| | | Size in Elements | Number of elements to read or write |
| | | Channel | 1 |
| | Target Device | Data Table Address | Type, in quotation marks [" "], the name of the tag in the ControlLogix controller (for example, "count"). |
| | | MultiHop | Select Yes |

2. On the MultiHop tab, specify:
   - the IP address of the EtherNet/IP communication module that is local to the Logix5000 controller.
   - the slot number of the Logix5000 controller.

# Send Email

## Introduction

This chapter describes how to send an email through an EtherNet/IP module.


| Topic | Page |
|---|---|
| EtherNet/IP Module as an Email Client | 119 |
| Send Email Via a Controller-initiated Message Instruction | 121 |
| Create String Tags | 121 |
| Enter the Ladder Logic | 125 |
| Configure the MSG Instruction That Identifies the Mail Relay Server | 125 |
| Configure the MSG Instruction That Contains the Email Text | 127 |
| Enter Email Text | 129 |
| Possible Email Status Codes | 129 |


For email, the EtherNet/IP module can be remote or local to the controller.

## EtherNet/IP Module as an Email Client

The EtherNet/IP module is an email client that uses a mail relay server to send email.

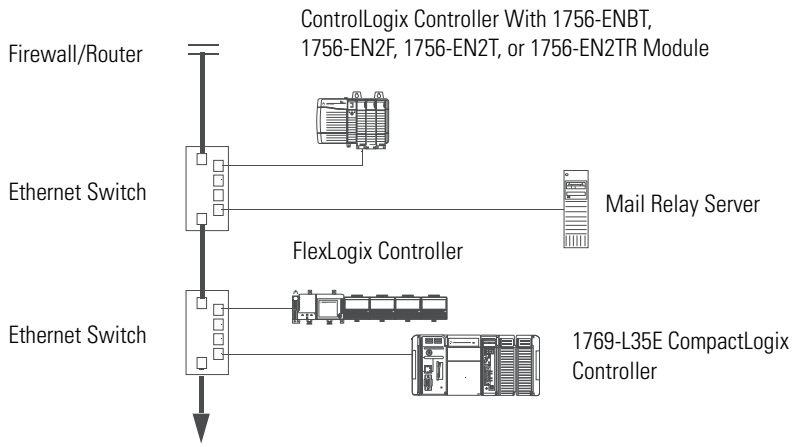
**IMPORTANT** The EtherNet/IP module can send an email to only one recipient at a time. It cannot mail to a distribution list.

**Ethernet Email**

| If you want to | Then |
|---|---|
| Send an email to specific personnel when a controller application generates an alarm or reaches a certain condition | Program the controller to send a MSG instruction to the EtherNet/IP module<br><br>The MSG instruction then instructs the EtherNet/IP module to send the email text (contained within the MSG instruction) to the mail relay server.<br><br>Multiple controllers can use the same EtherNet/IP module to initiate email. |
| Send controller or application status information on a regular basis to a project manager | |

The EtherNet/IP module sends only the content of a MSG instruction as an email to a mail relay server. Delivery of the email depends on the mail relay server. The EtherNet/IP module does not receive email.

### Sample System




### Sample System Capabilities

| Device | Capability |
|---|---|
| ControlLogix controller | Send a MSG instruction to the 1756-ENBT module to initiate sending an email to the mail relay server.<br><br>Use the path of the MSG instruction to identify the 1756-ENBT module as the target of the MSG instruction. |
| FlexLogix controller | |
| CompactLogix controller | |
| 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN2TXT module | Send an email to the mail relay server from the email interface on the Send an Email link.<br><br>This interface requires entry of all email information. |
| Mail relay server | Send email to specified recipients.<br><br>The mail relay server determines the delivery of any email sent through an EtherNet/IP module, whether via a MSG instruction or from its built-in interface. |

# Send Email Via a Controller-initiated Message Instruction

A Logix controller can send a generic CIP message instruction to the EtherNet/IP module that instructs the module to send an email message to a SMTP mail relay server using the standard SMTP protocol. This automatically communicates controller data and application conditions to appropriate personnel.

**IMPORTANT** Be careful to write the ladder logic to ensure the MSG instructions are not continuously triggered to send email messages.

Some mail relay servers require a domain name be provided during the initial handshake of the SMTP session. For these mail relay servers, specify a domain name when configuring the EtherNet/IP module's network settings.

For additional information, see Configure an EtherNet/IP Module to Operate on the Network on page 41.

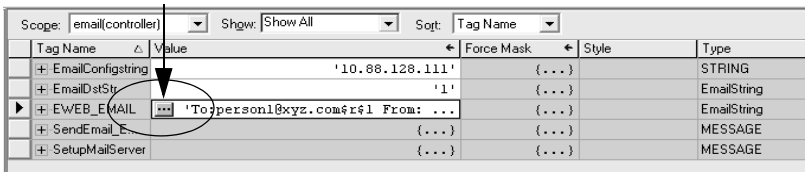
## Create String Tags

You need three controller-scoped string tags. Each tag performs one of these functions:

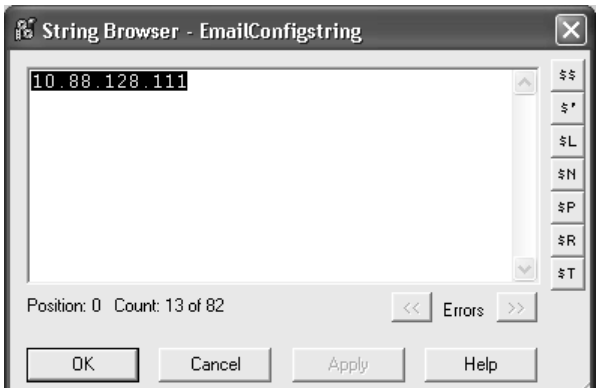
- Identifies the mail server
- Contains the email text
- Contains the status of the email transmission

The default STRING data type supports up to 82 characters. In most cases, this is sufficient to contain the address of the mail server. For example, to create tag EmailConfigstring of type STRING, perform this procedure.

1. Click ... in the Value column of the Controller Tags dialog box to display the String Browser dialog box.



The String Browser dialog box appears.



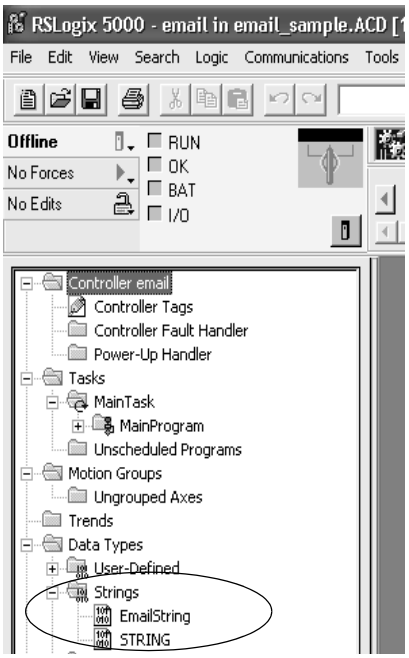

2. Enter the IP address or host name of the mail server.

3. Click OK.

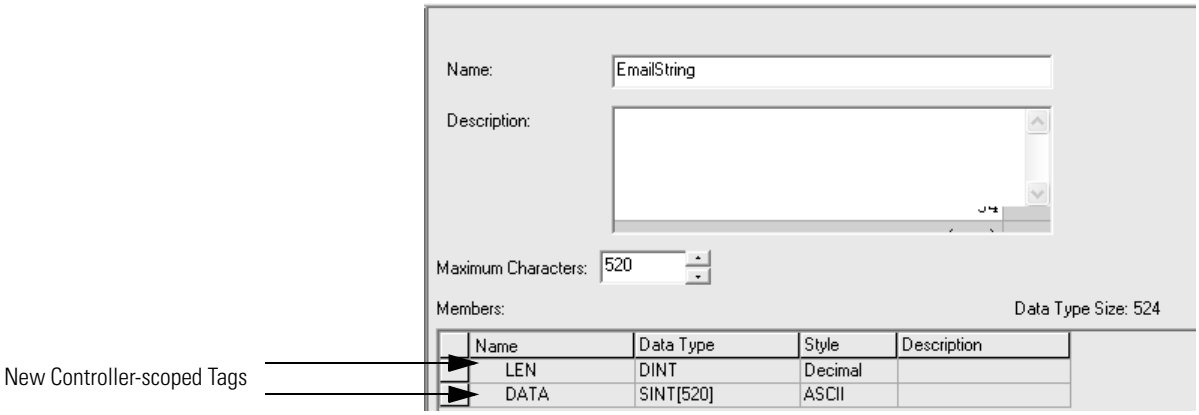
   The tags for the email text and transmission status can contain up to 474 characters. For these tags, you must create a user-defined STRING data type. The default STRING data type in RSLogix 5000 programming software is not large enough for most email text.

To create a user-defined STRING data type, perform this procedure.

1. In the Data Types folder in RSLogix 5000 programming software, navigate to the Strings folder and double-click a String data type.



The String dialog box appears.



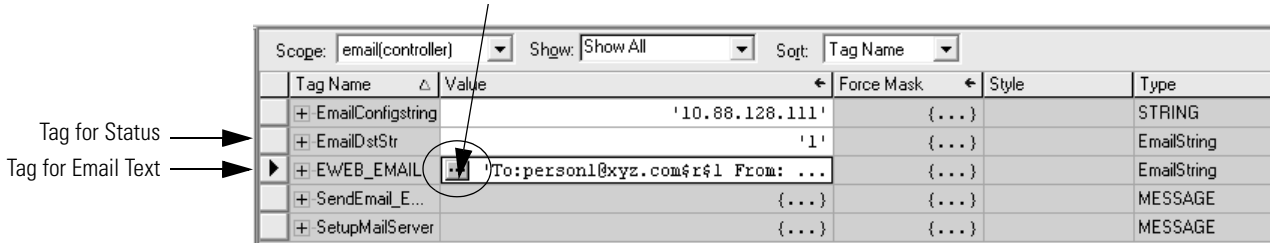

2. In the Name field, type a String type, such as EmailString.

3. Create one controller-scoped tag, such as EWEB_EMAIL, of this new data type to contain the email text.

4. Create a second controller-scoped tag, such as EmailDstStr, of this new data type to contain the transmission status.

   Both of these tags are of type EmailString.

5. Click ... in the Value column of the Controller Tags dialog box.




The String Browser dialog box appears.

6. Type your email.

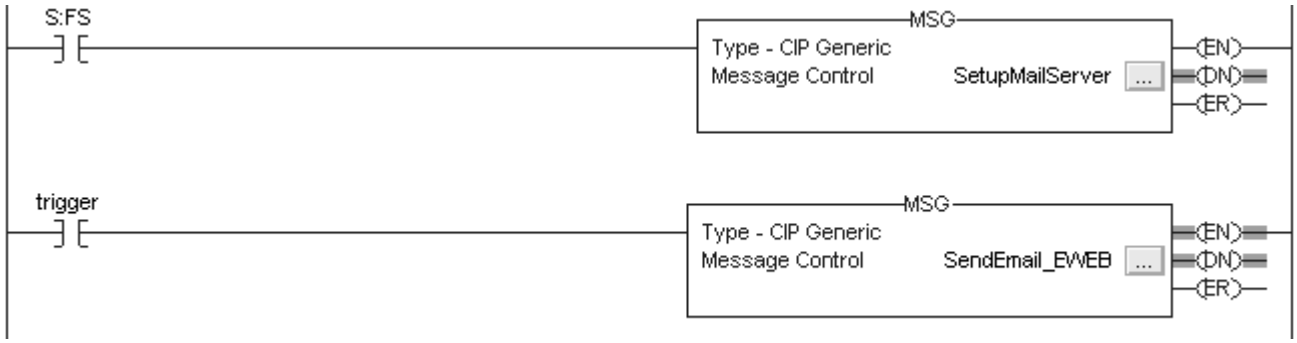
   The text of the email does not have to be static. You can program a controller project to collect specific data to be sent in an email.

7. Click OK.

For more information on using ladder logic to manipulate string data, see the Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

## Enter the Ladder Logic

Ladder logic requires two MSG instructions. One MSG instruction configures the mail server and needs to be executed only once. The second MSG instruction triggers the email. Execute this email MSG instruction as often as needed.

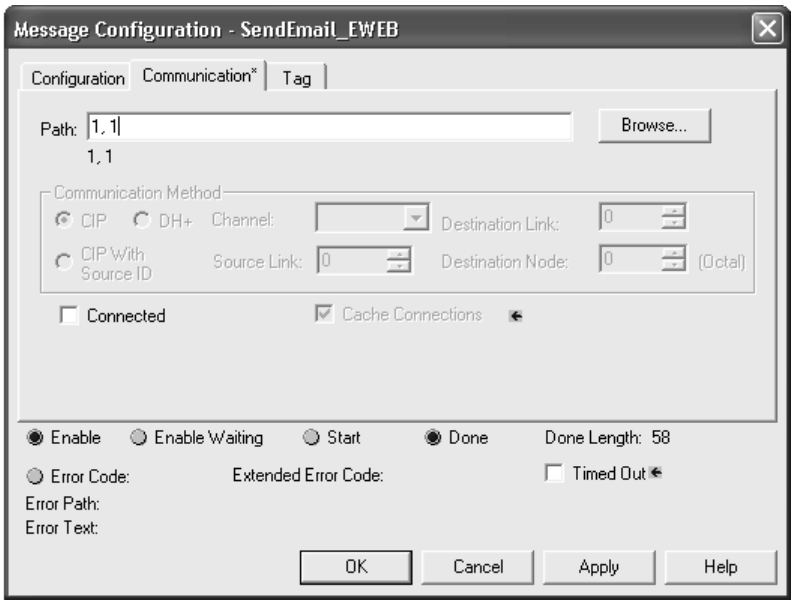



The first rung configures the mail server. The second rung sends the email text.

## Configure the MSG Instruction That Identifies the Mail Relay Server

To configure the MSG instruction that identifies the mail relay server, perform this procedure.

1. In the MSG instruction, click the Communication tab.



2. In the Path field, type the path for the MSG instruction.

   The path starts with the controller initiating the MSG instruction.

   a. Enter the number of the port from which the message exits and the address of the next module in the path.

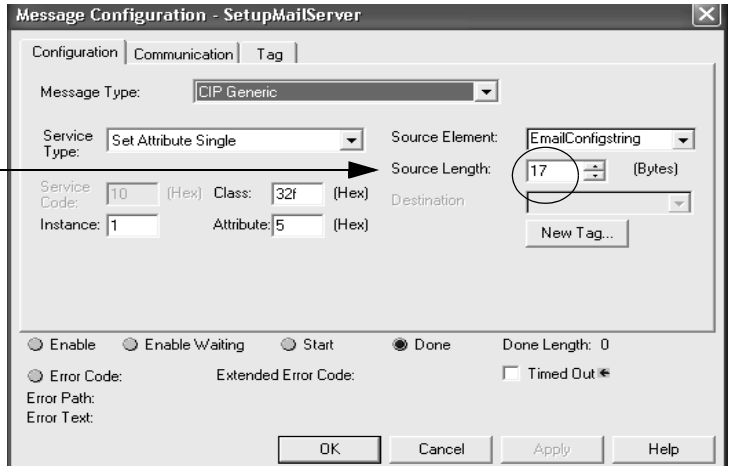
   For example, if the EtherNet/IP module is in the same chassis as the controller and is in slot 2, the path is: 1, 2.

   For more information on configuring the path of a MSG instruction, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

3. Click the Configuration tab.

The Source Length is the number of characters in the STRING tag that identifies the mail relay server plus 4 characters.

In this example, the tag contains 13 characters.




4. Configure the MSG parameters for sending an email.
   a. From the Service Type pull-down menu, choose Attribute Single
   b. In the Instance field, type 1.
   c. In the Class field, type 32f.
   d. In the Attribute field, type 5.
   e. From the Source Element pull-down menu, choose the tag that contains your email text.
   f. In the Source Length field, type the number of characters in the email plus four.

      In this example, you would enter 13 for the number of characters plus 4 for a total of 17.

   After the MSG instruction that configures the mail relay server executes successfully, the controller stores the mail relay server information in nonvolatile memory. The controller retains this information, even through power cycles, until another MSG instruction changes the information.

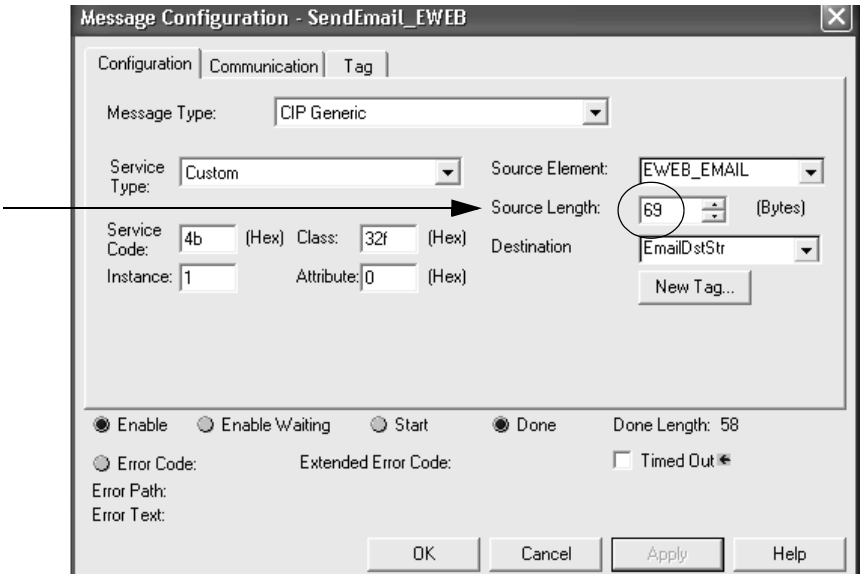
## Configure the MSG Instruction That Contains the Email Text

To configure the MSG instruction that contains the email text, perform this procedure.

1. Click the Configuration tab.

   The Source Length is the number of characters in the email tag plus 4 characters.

   In this example, the email text contains 65 characters.

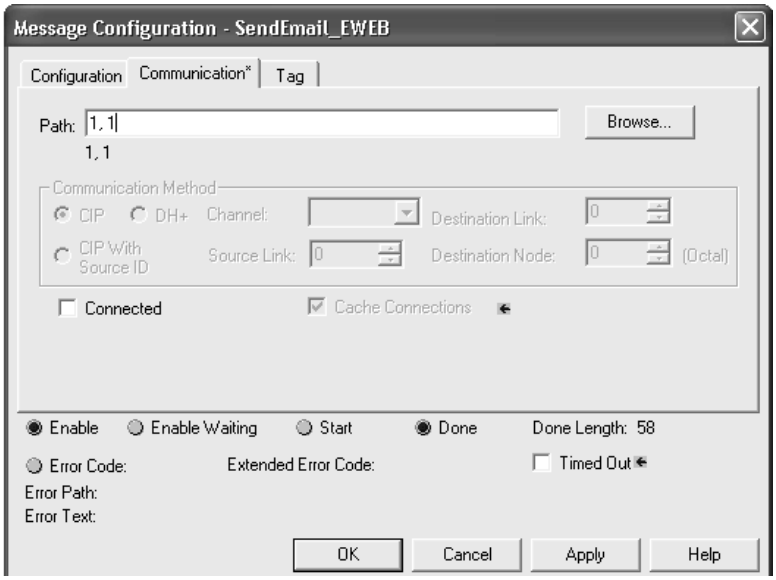



2. Configure the MSG parameters for sending an email.
   a. From the Service Type pull-down menu, choose Custom.
   b. In the Service Code field, type 4b.
   c. In the Instance field, type 1.
   d. In the Class field, type 32f.
   e. In the Attribute field, type 0.
   f. From the Source Element pull-down menu, choose the tag that contains your email text.
   g. In the Source Length field, type the number of characters in the email plus four.

      In this example, you would enter 65 for the number of characters plus 4 for a total of 69.

   h. From the Destination pull-down menu, choose a tag to contain the status of your email transmission.

3. Click the Communication tab.




4. In the Path field, type the path from the controller to the EtherNet/IP module.

   The path starts with the controller initiating the MSG instruction. The second number in the path represents the port from which the message exits and the address of the next module in the path.

   For example, if the EtherNet/IP module is in the same chassis as the controller and is in slot 2, the path is: 1, 2.

5. If all the devices in the path are configured in the initiating controller's I/O Configuration tree, click Browse to select the target module.

   The software automatically fills in the path.

6. Click OK.

For more information on configuring the path of an MSG instruction, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

## Enter Email Text

Use the string browser to enter the text of the email. To include To:, From:, and Subject: fields in the email, use <CR><LF> symbols to separate each of these fields. The To: and From fields are required; the Subject: field is optional. For example:

To: email address of recipient <CR><LF>
From: email address of sender <CR><LF>
Subject: subject of message <CR><LF>
body of email message

An email message must not exceed 474 characters in length. An additional 4-byte string-length value is added to the tag. As a result, the maximum source length is 478 characters.

## Possible Email Status Codes

Examine the destination element of the email MSG to see whether the email was successfully delivered to the mail relay server. A successful delivery indicates that the mail relay server placed the email message in a queue for delivery, but it does not mean the intended recipient received the email message. These are the possible codes that a destination element could contain.

**Email Status Code Descriptions**

| Error Code (Hex) | Extended-error Code (Hex) | Description |
|---|---|---|
| 0x00 | None | Delivery successful to the mail relay server. |
| 0x02 | None | Resource unavailable. The email object was unable to obtain memory resources to initiate the SMTP session. |
| 0x08 | None | Unsupported Service Request. Make sure the service code is 0x4B and the Class is 0x32F. |
| 0x11 | None | Reply data too large. The Destination string must reserve space for the SMTP server reply message. The maximum reply can be 470 bytes. |
| 0x13 | None | Configuration data size too short. The Source Length is less than the Source Element string size plus the 4-byte length. The Source Length must equal the Source Element string size + 4. |
| 0x15 | None | Configuration data size too large. The Source Length is greater than the Source Element string size plus the 4-byte length. The Source Length must equal the Source Element string size + 4. |
| 0x19 | None | Data write failure. An error occurred when attempting to write the SMTP server address (attribute 4) to non-volatile memory. |
| 0xFF | 0x0100 | Error returned by email server; check the Destination string for reason. The email message was not queued for delivery. |
| | 0x0101 | SMTP mail server not configured. Attribute 5 was not set with a SMTP server address. |
| | 0x0102 | “To:” address not specified. Attribute 1 was not set with a “To:” address AND there is not a “To:” field header in the email body. |
| | 0x0103 | “From:” address not specified. Attribute 2 was not set with a “From:” address AND there is not a “From:” field header in the email body. |

**Email Status Code Descriptions**

| Error Code (Hex) | Extended-error Code (Hex) | Description |
|---|---|---|
| 0xFF | 0x0104 | Unable to connect to SMTP mail server set in Attribute 5. If the mail server address is a host name, make sure that the device supports DNS, and that a Name Server is configured. If the hostname is not fully qualified, for example, "mailhost" and not "mailhost.xx.yy.com" then the domain must be configured as "xx.yy.com". Try "ping <mail server address>" to insure the mail server is reachable from your network. Also try "telnet <mail server address> 25" which attempts to initiate a SMTP session with the mail server via telnet over port 25. (If you connect then enter "QUIT"). |
| | 0x0105 | Communication error with SMTP mail server. An error occurred after the initial connection with the SMTP mail server.<br>See the ASCII text following the error code for more details as to the type of error. |
| | 0x0106 | SMTP mail server host name DNS query did not complete. A previous send service request with a host name as the SMTP mail server address did not yet complete. Note that a timeout for a DNS lookup with an invalid host name can take up to 3 minutes. Long timeouts can also occur if a domain name or name server is not configured correctly. |

# Communicate with PanelView Terminals

## Introduction

This chapter describes how a controller uses an EtherNet/IP communication module to communicate with PanelView and PanelView Plus terminals over an EtherNet/IP network.

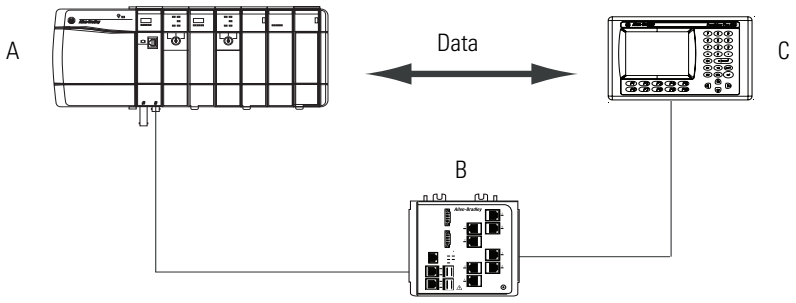

| Topic | Page |
|---|---|
| Set Up the Hardware | 131 |
| Connections to PanelView Terminals | 132 |
| Add a PanelView Terminal | 133 |
| Organize Controller Data for a PanelView Terminal | 136 |
| Connections to RSView Applications | 136 |


## Set Up the Hardware

In this example, the controller in the local chassis shares data with an HMI application on the EtherNet/IP network. This application could be running a:

- PanelView terminal.
- PanelView Plus terminal.
- workstation running RSView 32 software.
- workstation running an RSView Enterprise application, such as RSView Machine Edition or RSView Supervisory Edition.

**Ethernet Communication with Panelview**




| Item | Description |
|---|---|
| A | Local chassis containing a Logix5000 controller and EtherNet/IP connection |
| B | Switch |
| C | HMI device with EtherNet/IP connectivity |

## Logix5000 Controller Combinations

**Choosing a Communication Module**

| Controllers | Communication Modules |
|---|---|
| 1756 ControlLogix | 1756-ENBT, 1756-EN2F, 1756-EN2T, 1756-EN2TR, or 1756-EN2TXT communication modules |
| 1768 CompactLogix | 1768-ENBT communication module |
| 1769-L23E-Q1B, 1769-L23E-QBFC1B, 1769-L32E, or 1769-L35E CompactLogix | A built-in EtherNet/IP port |
| 1794 FlexLogix | 1788-ENBT EtherNet/IP communication module |
| PowerFlex 700S with DriveLogix | 1788-ENBT EtherNet/IP communication module |

Make sure to:

- set the IP addresses for the controller's EtherNet/IP communication module and the HMI terminal.
- connect all wiring and cabling.

## Connections to PanelView Terminals

To establish communication between a PanelView or PanelView Plus terminal, specify controller connections.

**PanelView Terminal Connections**

| Type of Communication | Terminal Type | |
|---|---|---|
| | PanelView | PanelView Plus |
| Implicit (connected)<br>• Logix controller communicates to the PanelView terminal like an I/O module.<br>• You must add the PanelView terminal to the I/O configuration tree for the controller project. | Supported | Not supported |
| Explicit (unconnected)<br>• Communication is set up in PanelBuilder or RSView ME software.<br>• All communication is initiated by the PanelView or PanelView Plus terminal. | Supported | Supported |

When communicating implicitly (PanelView terminals only), the controller uses one connection for each terminal. Make sure to account for these connections when designing the system. The Logix5000 controllers:

- firmware revisions 11 and earlier support up to 16 bidirectional implicit buffers (connections).
- firmware revisions 12 or later support up to 32 bidirectional implicit buffers (connections).

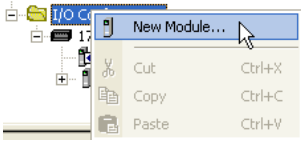
The larger number of implicit buffers enables significantly more PanelView terminals to simultaneously request data from the controller via implicit communication.

When communicating explicitly, the controller supports 40 outgoing and 3 incoming buffers. This number of incoming buffers limits how many terminals can simultaneously request data from a controller via explicit communication. In other words, while a system can have multiple terminals, only three terminals can explicitly request data from a Logix controller at the same time.

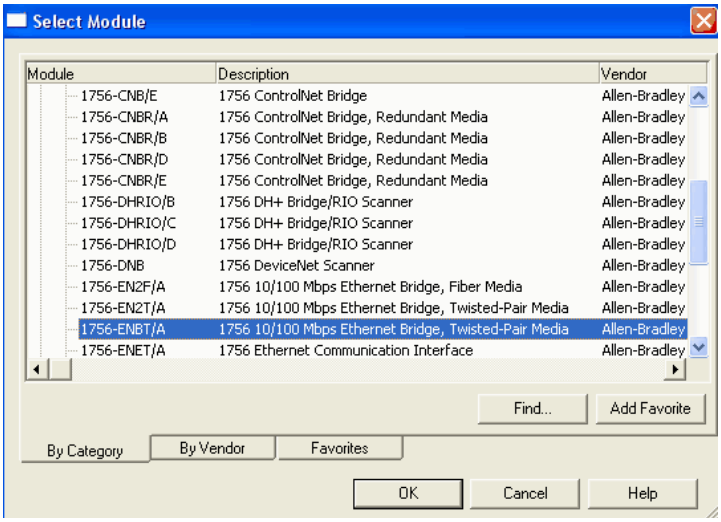
## Add a PanelView Terminal

To add a Panelview terminal, perform this procedure.

1. In the Controller Organizer of the RSLogix 5000 programming software, right-click I/O Configuration to select New Module.



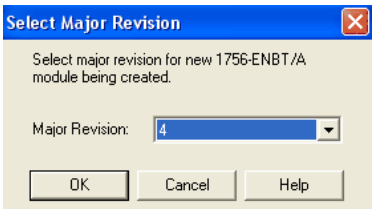

The Select Module dialog box appears.


Select Module
Module
Description
Vendor
1756-CNB/E 1756 ControlNet Bridge Allen-Bradley
1756-CNBR/A 1756 ControlNet Bridge, Redundant Media Allen-Bradley
1756-CNBR/B 1756 ControlNet Bridge, Redundant Media Allen-Bradley
1756-CNBR/D 1756 ControlNet Bridge, Redundant Media Allen-Bradley
1756-CNBR/E 1756 ControlNet Bridge, Redundant Media Allen-Bradley
1756-DHRIO/B 1756 DH+ Bridge/RIO Scanner Allen-Bradley
1756-DHRIO/C 1756 DH+ Bridge/RIO Scanner Allen-Bradley
1756-DHRIO/D 1756 DH+ Bridge/RIO Scanner Allen-Bradley
1756-DNB 1756 DeviceNet Scanner Allen-Bradley
1756-EN2F/A 1756 10/100 Mbps Ethernet Bridge, Fiber Media Allen-Bradley
1756-EN2T/A 1756 10/100 Mbps Ethernet Bridge, Twisted-Pair Media Allen-Bradley
1756-ENBT/A 1756 10/100 Mbps Ethernet Bridge, Twisted-Pair Media Allen-Bradley
1756-ENET/A 1756 Ethernet Communication Interface Allen-Bradley
Find...
Add Favorite
By Category
By Vendor
Favorites
OK
Cancel
Help

2. Click the By Category tab.

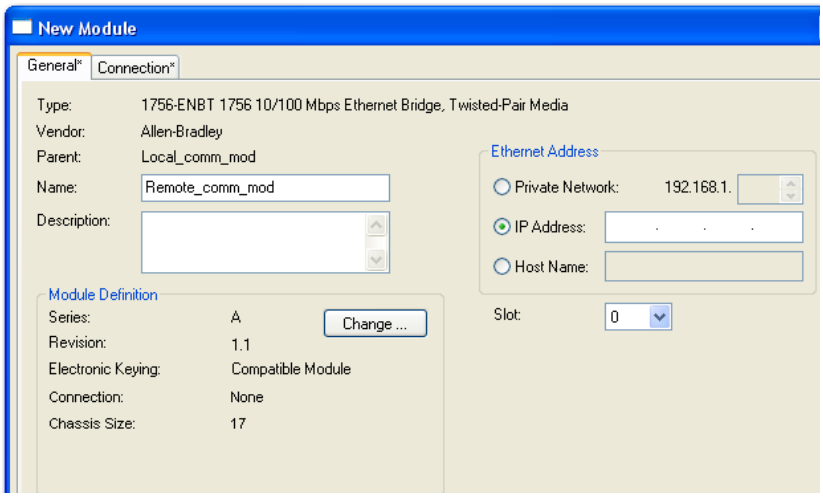
3. Browse to your EtherNet/IP communication module and click OK.

The Select Major Revision dialog box appears.



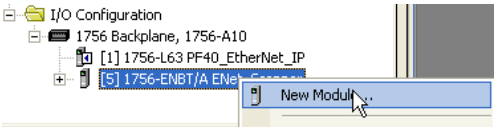
4. From the Major Revision pull-down menu, choose a revision and click OK.

   The New Module dialog box appears.



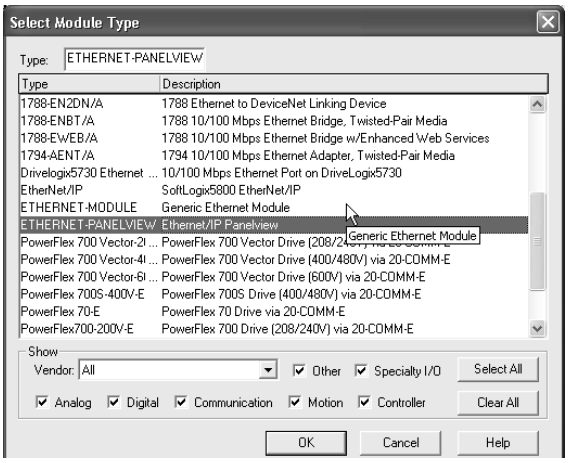

   a. In the Name field, type the name of your new module.
   b. From the Comm Format pull-down menu, choose a communication format.
   c. In the Slot field, type the number of the slot where the new module will reside.
   d. In Chassis Size field, type the chassis size.
   e. In the IP Address field, type the IP address.
   f. From the Electronic Keying pull-down menu, choose Disable Keying and click OK.

5. In the Controller Organizer of RSLogix 5000 programming software, right-click the local EtherNet/IP communication module you just added and select New Module.



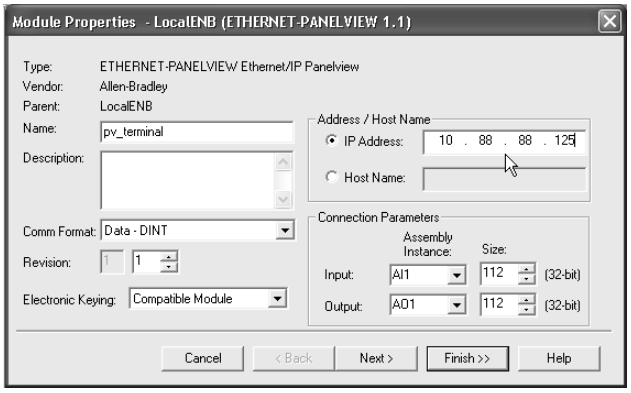
The Select Module Type dialog box appears.

6. Right-click to select New Module, and add an ETHERNET-PANELVIEW.




7. Click OK.

The Module Properties dialog box appears.




a. In the Name field, type the name of your new module.

b. From the Comm Format pull-down menu, choose Data-DINT.

c. From the Electronic Keying pull-down menu, choose Disable Keying.

d. In the IP Address field, type the IP address.

e. In the Input and Output fields, type the connection parameters.

**IMPORTANT** You can establish up to eight different instances with each terminal. For example, one controller can use all eight instances. Or eight controllers can each use one instance.

f. Click Finish.

## Organize Controller Data for a PanelView Terminal

Organize data for a PanelView terminal based on how the data is used.

**Controller Data Organization**

| For data that is | Do this |
|---|---|
| Time critical (for example, data that controls a machine) | Use the I/O tags of the terminal.<br><br>The tags for this data were created when you added the terminal to the I/O configuration of the controller. They resemble the I/O modules' tags. |
| Not time critical | Create arrays to store the data.<br><br>1. For each screen, create a BOOL array with enough elements for the bit-level objects on the screen.<br><br>For example, the BOOL[32] array gives you 32 bits for push buttons or indicators.<br><br>2. For each screen, create a DINT array with enough elements for the word-level objects on the screen.<br><br>For example, the DINT[28] array provides 28 values for numeric entry controls or numeric displays. |

To access the I/O tags of the PanelView or PanelView Plus terminal, use the following address format:

| Terminal Function | Requirement |
|---|---|
| Writes the data | name_of_terminal:I.Data[x].y |
| Reads the data | name_of_terminal:O.Data[x].y |

where:

| This address variable | Is |
|---|---|
| name_of_terminal | Name of the instance in the I/O configuration of the controller. |
| x | Element of the input (I) or output (O) structure. |
| y | Bit number within the input or output element. |

## Connections to RSView Applications

To establish communication to an RSView application, configure RSLinx software to collect tags from the controller. An RSView 32 or RSView Enterprise application uses RSLinx software as a data server.

RSLinx Enterprise software defaults to four read connections and one write connection per configured controller. Modify the RSLinx software configuration as needed.

# Monitor Diagnostics

## Introduction

The EtherNet/IP communication modules provide several web diagnostic pages. This chapter illustrates each of these web diagnostic pages and defines the terms presented on each screen.


| Topic | Page |
|---|---|
| Diagnostic Web Pages | 138 |
| Network Settings | 141 |
| Explicit Message Connections | 142 |
| I/O Connections | 143 |
| Ethernet Statistics | 144 |

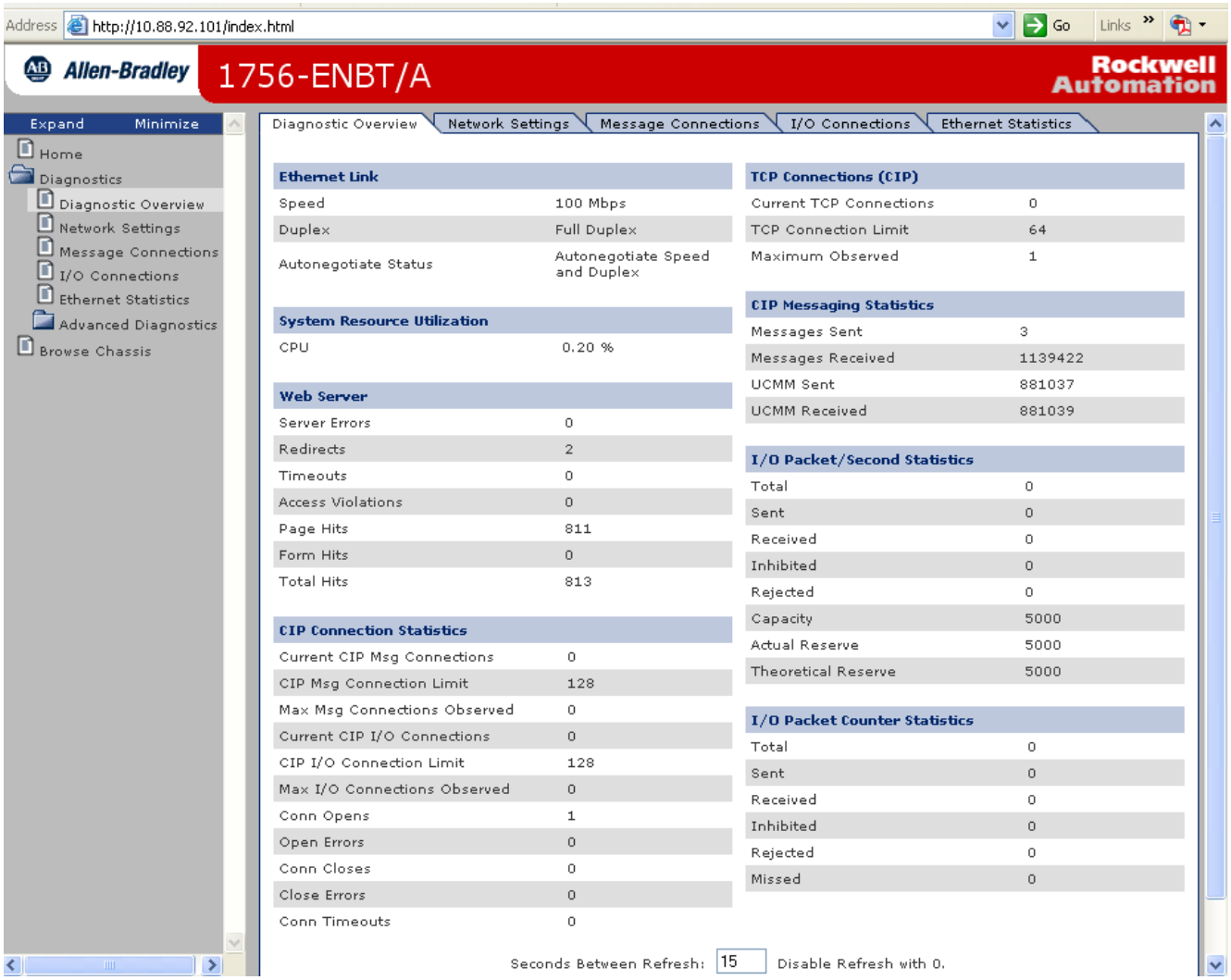

**IMPORTANT**

To access any of these diagnostic web pages and troubleshoot problems which you may be able to diagnose via one of these web diagnostic pages, see Troubleshoot an EtherNet/IP Module on page 147.

A 1783-ETAP tap using firmware revision 1.1 does not support diagnostic web pages. You must upgrade the tap to firmware revision 2.x or later to use diagnostic web pages.

# Diagnostic Web Pages

The Diagnostic Overview web page presents a summary of the current configuration and overall status of the module.




**Diagnostic Overview Web Page**

| This field | Specifies |
|---|---|
| **Ethernet Link** | |
| Speed | Whether the Ethernet port is operating at 10 Mbps or 100 Mbps. |
| Duplex | Whether the Ethernet port is operating at half duplex or full duplex. |
| Autonegotiate Status | Whether the port speed and duplex mode were determined via autonegotiation or manual configuration. |
| **System Resource Utilization** | |
| CPU | Current percent CPU utilization for the module. |
| **Web Server** | |
| Server Errors | Number of requests to the module with an invalid URL. |

**Diagnostic Overview Web Page**

| This field | Specifies |
|---|---|
| Redirects | Number of requests for a Web page that were redirected by the module (for example, requesting "/" is redirected to "/index.html"). |
| Timeouts | Number of times a connection timeout occurred while processing a Web page. |
| Access Violations | Number of times a page has been requested for which the user has insufficient privilege. |
| Page Hits | Number of times a Web page was successfully accessed. |
| Form Hits | Number of times a Web page form was accessed. |
| Total Hits | Total number of Web page access attempts. |
| **CIP Connection Statistics** | |
| Current CIP MSG Connections | Current number of CIP connections for message. |
| CIP MSG Connection Limit | Maximum number of CIP connections for messages allowed. |
| Max MSG Connections Observed | Maximum observed number of CIP connections for messages. |
| Current CIP I/O Connections | Current number of CIP connections for I/O. |
| CIP I/O Connection Limit | Maximum number of CIP connections allowed for I/O. |
| Max I/O Connections Observed | Maximum observed number of CIP connections for I/O. |
| Conn Opens | Number of CIP connection open requests. |
| Open Errors | Number of CIP connection open request errors. |
| Conn Closes | Number of CIP connection close requests. |
| Close Errors | Number of CIP connection close request errors. |
| Conn Timeouts | Number of CIP connection timeouts. |
| **TCP Connections (CIP)** | |
| Current TCP Connections | Current number of active TCP connections for CIP messaging. |
| TCP Connection Limit | Maximum number of TCP connections for CIP messaging allowed. |
| Maximum Observed | Maximum observed number of TCP connections for CIP messaging. |
| **CIP Messaging Statistics** | |
| Messages Sent | Number of CIP connected messages (packets) sent. |
| Messages Received | Number of CIP connected messages (packets) received. |
| UCMM Sent | Number of CIP unconnected messages (packets) sent. |
| UCMM Received | Number of CIP unconnected messages (packets) received. |
| **I/O Packet / Second Statistics** | |
| Total | Total number of Class 1 UDP packets the module transmitted and received in the last one-second snapshot.<br><br>The Total is the sum of the Sent, Received, Inhibited, and Rejected numbers. |
| Sent | Number of Class 1 UDP packets the module transmitted in the last one-second snapshot. |
| Received | Number of Class 1 UDP packets the module received in the last one-second snapshot. |
| Inhibited | Number of Class 1 UDP packets the module inhibited in the last one-second snapshot.<br><br>Packets are inhibited if a COS module produces packets faster than 25% of the connection's RPI. |

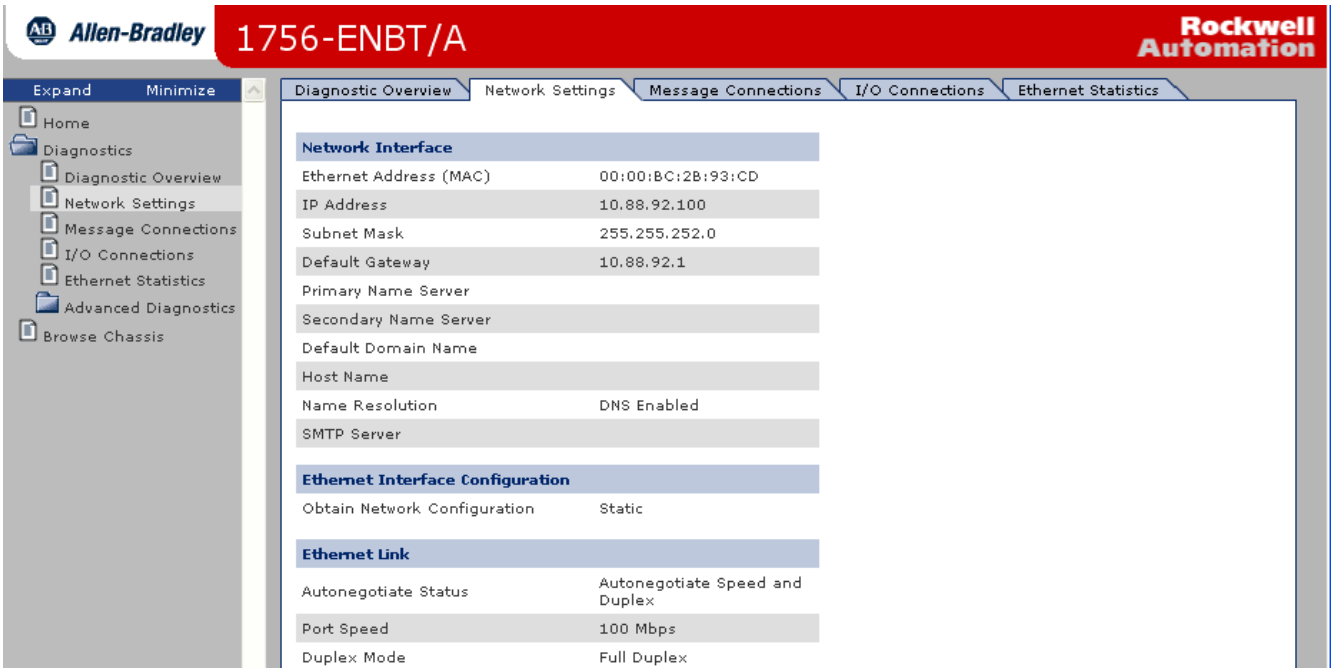
**Diagnostic Overview Web Page**

| This field | Specifies |
|---|---|
| Rejected | Number of Class 1 UDP packets the module rejected in the last one-second snapshot.<br><br>These packets were messages received and then rejected because the connection was closed or there was a duplicate multicast address. |
| Capacity | Number of Class 1 UDP packets the module can handle over the Ethernet network at any time. |
| Actual Reserve | Actual Reserve = Capacity - Total.<br><br>This is based on the total of number packets the module has transmitted/received in the last one-second snapshot. |
| Theoretical Reserve | Theoretical Reserve = Capacity - the sum of the theoretical packet/second of all connections based on the RPI. |
| **I/O Packet Counter Statistics** | |
| Total | Cumulative number of Class 1 UDP packets the module transmitted/received.<br><br>The Total is the sum of the Sent, Received, Inhibited, and Rejected numbers. |
| Sent | Cumulative number of Class 1 UDP packets the module transmitted. |
| Received | Cumulative number of Class 1 UDP packets the module received. |
| Inhibited | Cumulative number of Class 1 UDP packets the module inhibited.<br><br>Packets are inhibited if a COS module produces packets faster than 1/4 of the connection's RPI. |
| Rejected | Cumulative number of Class 1 UDP packets the module rejected.<br><br>These packets were messages received and then rejected because the connection was closed or there was a duplicate multicast address. |
| Missed | Cumulative number packets that were not received in order.<br><br>Each UDP packet has a sequence number and if a packet is missing (corrupted or dropped), the module will recognize this void upon receipt of the next packet received. |

## Network Settings

The Network Settings web page presents a summary of the current Ethernet configuration for the module. This information advises you what has and has not been configured and has nothing directly to do with troubleshooting.

**IMPORTANT** Any unconfigured fields remain blank.




**Network Settings Web Page**

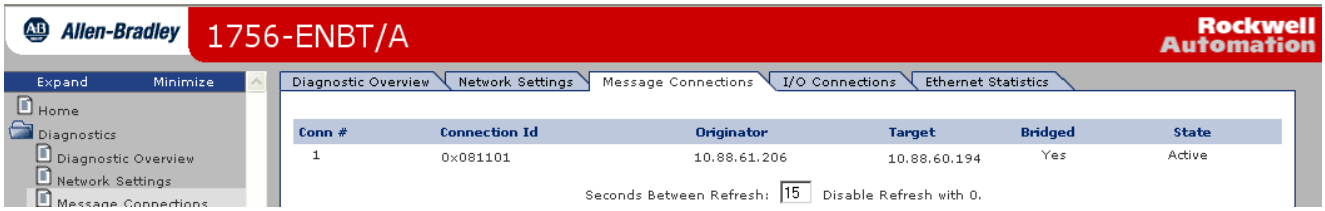
| This field | Specifies |
|---|---|
| **Network Interface** | |
| Ethernet Address (MAC) | Ethernet (MAC) address of the module. |
| IP Address | IP address for the module. |
| Subnet Mask | Subnet mask for the module. |
| Default Gateway | Gateway address for the module. |
| Primary Name Server | Primary name server. |
| Secondary Name Server | Secondary name server. |
| Default Domain Name | Default domain name for the module. |
| Host Name | Host name for the module. |
| Name Resolution | Whether or not Domain Name System (DNS) resolution is enabled. |
| SMTP Server | SMTP server address for the module (required for email). |

**Network Settings Web Page**

| This field | Specifies |
|---|---|
| **Ethernet Interface Configuration** | |
| Obtain Network Configuration | Whether the module is configured to obtain its network parameters (IP address) via BOOTP, DHCP, or from static configuration. |
| **Ethernet Link** | |
| Autonegotiate Status | Whether the Ethernet port is operating at 10 or 100 MBps. |
| Port Speed | Whether the Ethernet port is operating at half duplex or full duplex. |
| Duplex Mode | Whether the port speed and duplex mode were determined via autonegotiation or manual configuration. |

# Explicit Message Connections

The Message Connections diagnostic web page presents a summary of messages bridged through or initiated by the module.

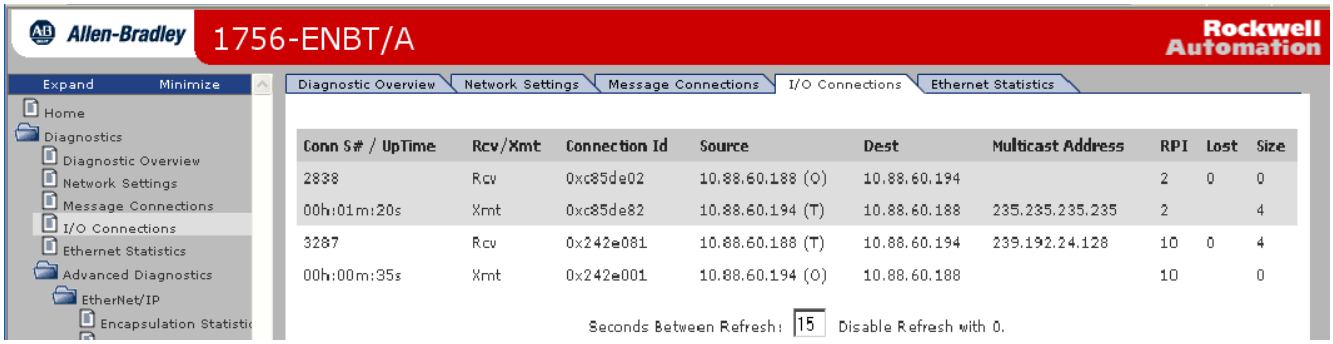



**Message Connections Web Page**

| This field | Specifies |
|---|---|
| Conn # | The relative index of this connection (on the Message Connections page). |
| Connection ID | The unique identifier for each connection. |
| Originator | The IP address of the device that originated the connection on an Ethernet network. |
| Target | The IP address of the device that is the target of the connection on an Ethernet network.<br><br>This may not be the ultimate target of the connection. For example, the target could be a Logix controller in a chassis. |
| Bridged | Whether the connection bridges through the module. |
| State | The current state of the connection:<br>· Active<br>· Closing<br>· Faulted<br>· Reserved |

# I/O Connections

The I/O Connections diagnostic web page presents a summary of I/O connections initiated by the module.




Each Class 1 UDP connection has a receive/transmit (Rcv/Xmt) pair of data and heartbeat. The originator of a connection listens on the multicast address to receive the data. The target of the connection receives the heartbeat.

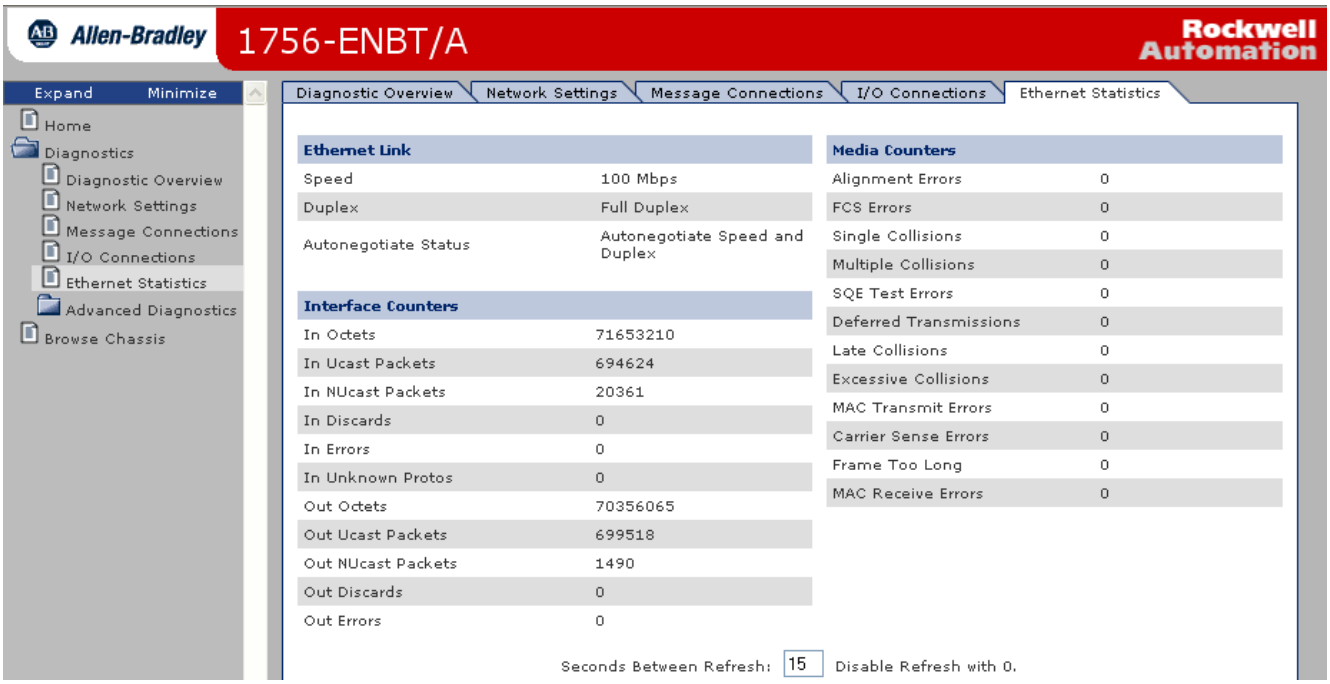
In this example, the Web page is for the module at address 10.88.60.194. This module (10.88.60.194) originated a connection to 10.88.60.188 with an RPI of 10.

### I/O Connections Web Page

| This field | Specifies |
|---|---|
| Conn S#/Up Time | Connection serial number and the elapsed time the connection has been maintained. |
| Rcv/Xmt | Connection was received or transmitted from this source address. |
| Connection ID | Connection identifier. |
| Source | IP address of the Rcv/Xmt packet.<br>(T) = target; (O) = originator. |
| Dest | Destination address. |
| Multicast Address | Connection targets produce at this multicast address.<br>Connection originators listen on this multicast address. |
| RPI | Programmed connection RPI. |
| Lost | Total number of packets received where the Common Packet Encapsulation sequence number is less than the last received on this connection. |
| Size | Size of class 1 UDP packet data (in bytes). |

# Ethernet Statistics

The Ethernet Statistics diagnostic web page presents a summary of the status of communication activity on the Ethernet network.




**Ethernet Statistics Web Page**

| This field | Specifies |
|---|---|
| **Ethernet Link** | |
| Speed | Whether the Ethernet port is operating at 10 or 100 MBps. |
| Duplex | Whether the Ethernet port is operating at half duplex or full duplex. |
| Autonegotiate Status | Whether the port speed and duplex mode were determined via autonegotiation or whether they were manually configured. |
| **Interface Counters** | |
| In Octets | Octets received on the Ethernet interface. |
| In Ucast Packets | Unicast packets received on the Ethernet interface. |
| In NUcast Packets | Nonunicast packets received on the Ethernet interface. |
| In Discards | Inbound packets received on the Ethernet interface but discarded. |
| In Errors | Inbound packets that contain errors, not including Discards. |
| In Unknown Protos | Inbound packets with unknown protocol. |
| Out Octets | Octets sent on the Ethernet interface. |
| Out Ucast Packets | Unicast packets sent on the Ethernet interface. |
| Out NUcast Packets | Nonunicast packets sent on the Ethernet interface. |
| Out Discards | Outbound packets discarded. |
| Out Errors | Outbound packets that contain errors. |

**Ethernet Statistics Web Page**

| This field | Specifies |
|---|---|
| **Media Counters** | |
| Alignment Errors | A frame containing bits that do not total an integral multiple of eight. |
| FCS Errors | A frame containing eight bits, at least one of which has been corrupted. |
| Single Collisions | The number of outgoing packets that encountered only one collision during transmission. |
| Multiple Collisions | The number of outgoing packets that encountered 2...15 collisions during transmission. |
| SQE Test Errors | A test to detect the collision-present circuit between a transceiver and a network interface card (NIC).<br><br>**Important:** Because most NICs now have an integrated transceiver, the SQE test is unnecessary. Ignore this media counter. |
| Deferred Transmissions | The number of outgoing packets whose transmission is deferred because the network is busy when the first attempt is made to send them. |
| Late Collisions | The number of times two devices transmit data simultaneously. |
| Excessive Collisions | The number of frames that experience 16 consecutive collisions. |
| MAC Transmit Errors | Frames for which transmission fails due to an internal MAC sublayer transmit error. |
| Carrier Sense Errors | Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame. |
| Frame Too Long | The number of incoming packets that exceed the maximum Ethernet packet size. |
| MAC Receive Errors | Frames for which reception on the Ethernet interface failed due to an internal MAC sublayer receive error. |

## Notes:

# Troubleshoot an EtherNet/IP Module

## Introduction

This chapter explains how to troubleshoot problems with your EtherNet/IP communication modules.


| Topic | Page |
|---|---|
| Access Web Browser Support | 147 |
| Switch Considerations | 157 |
| Internet Group Multicast Protocol | 157 |
| Virtual Local Area Networks | 158 |
| Port Mirroring | 159 |


**Troubleshooting Content Guide**

| For | Consult these sections |
|---|---|
| Basic troubleshooting help | Web Browser Support |
| Advice on choosing the correct switch to troubleshoot module problems | Switch Considerations |
| Advanced troubleshooting help | • Internet Group Multicast Protocol<br>• Virtual Local Area Networks<br>• Port Mirroring |

## Access Web Browser Support

To troubleshoot most possible problems with your EtherNet/IP communication module, you need to access the module's diagnostic web pages.

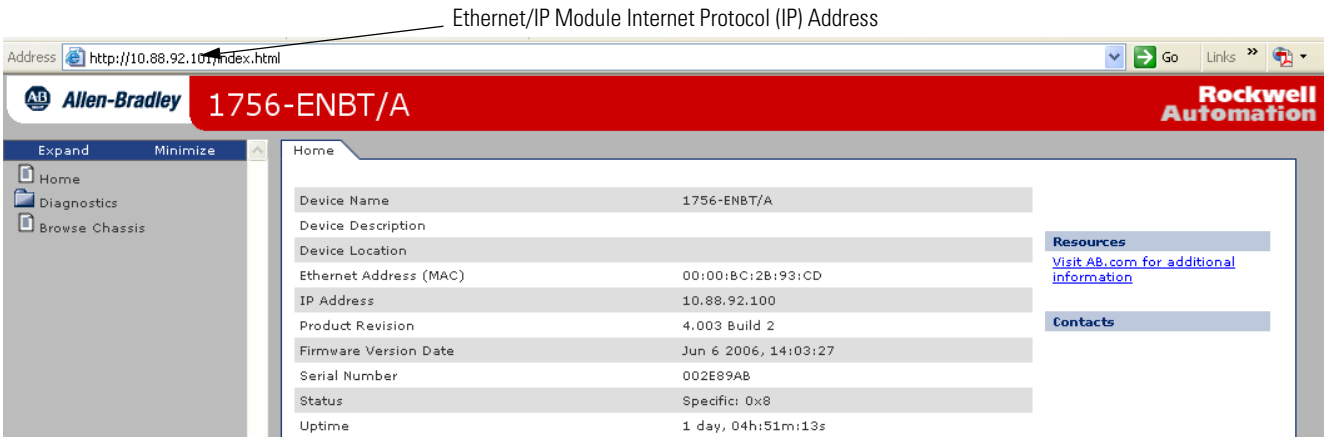
**Required Web Diagnostic Pages**

| Technical Issue | Web Diagnostic Page |
|---|---|
| Port speed or settings | Diagnostic Overview Statistics |
| Required converter type | |
| CPU utilization | |
| Number of missed I/O packets | |
| Status of connections | Message Connections |
| Status of I/O connections | I/O Connections |
| Number of lost I/O connections | |
| Intermittent Ethernet connectivity | Ethernet Statistics |

To access your EtherNet/IP communication module diagnostic web pages, perform this procedure.

1. Open your web browser.
2. In the Address field, type your EtherNet/IP module internet protocol (IP) address and hit Enter.

   The diagnostic web home page appears.




**IMPORTANT** The diagnostic web pages illustrated in this chapter use the 1756-ENBT EtherNet/IP module as an example. It is not the only EtherNet/IP module that supports web diagnostic pages.

## Diagnostic Overview Statistics

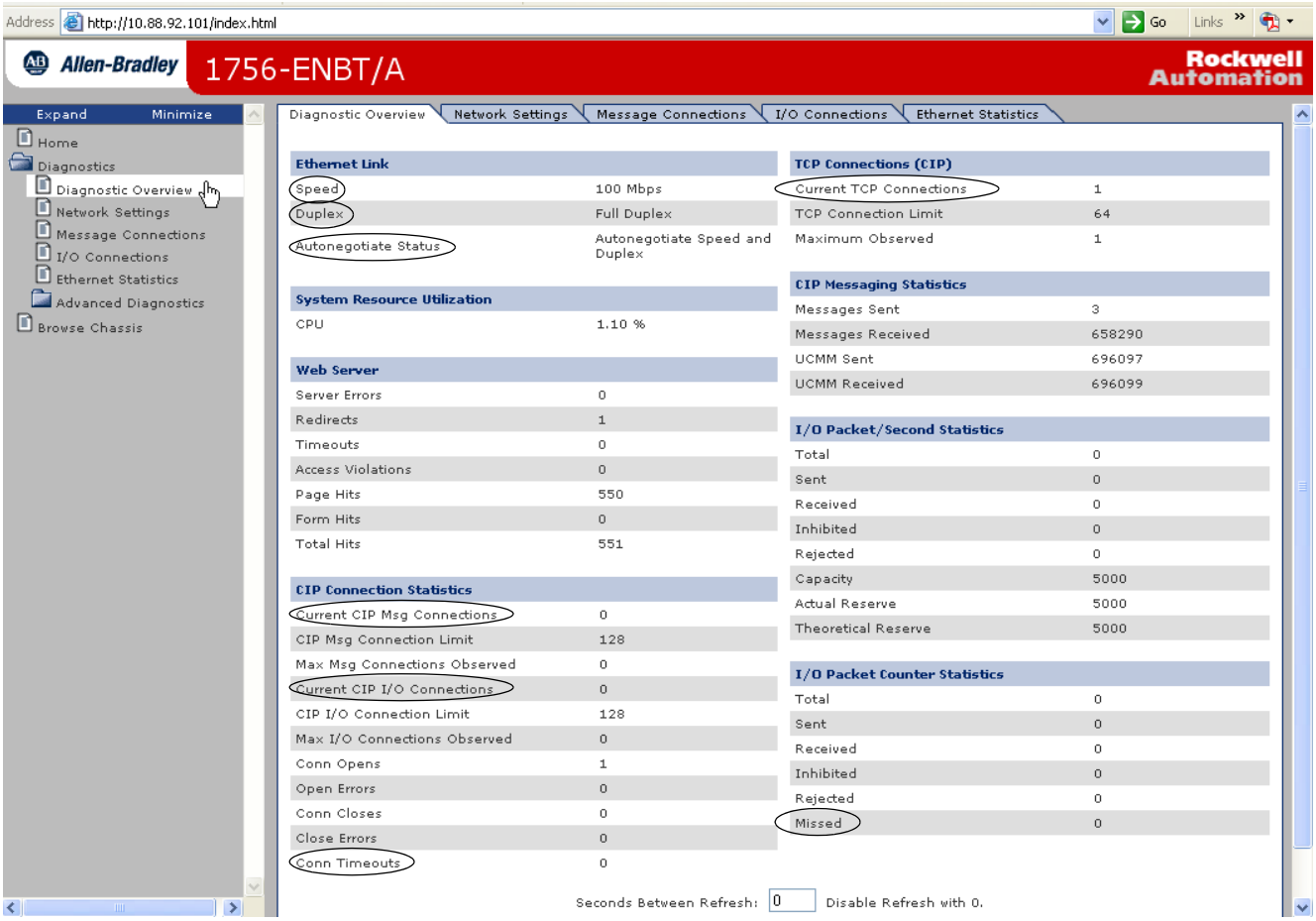
To view the diagnostic overview statistics for your EtherNet/IP communication module, perform this procedure.

1. Open the Diagnostics folder and select Diagnostics Overview.

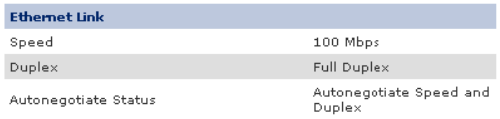
The Diagnostic Overview web page appears, along with the tabs for the other four diagnostic web pages.

**IMPORTANT** The Network Settings web page shows your module's configuration settings and is not used in the troubleshooting process.

We recommend that you monitor the diagnostics circled in the graphic below.



2. Review the values in the Ethernet Link table.



| Ethernet Link | |
|---|---|
| Speed | 100 Mbps |
| Duplex | Full Duplex |
| Autonegotiate Status | Autonegotiate Speed and Duplex |

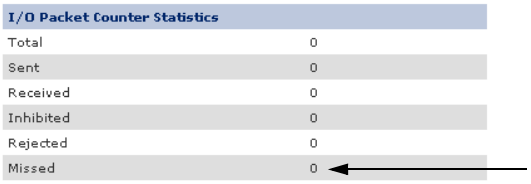
| If | | And you | Then |
|---|---|---|---|
| Speed is | 100 or 1000 Mbps | Do not want to change your port speed | No action is required.<br><br>**Important:** 100 Mbps is the default port speed. |
| | | Want to reduce your port speed to 10 Mbps | You must manually configure your module and reset your module. See Configure the Module with RSLinx Software on page 48. |
| | 10 Mbps | Want to increase your port speed to 100 Mbps | Reset your module or see Configure the Module with RSLinx Software on page 48. |
| | | Do not want to change your port speed | No action is required. |
| Duplex is | Full | Are sending large amounts of data | No action is required.<br><br>**Important:** Full Duplex is the default port setting.<br><br>Full-duplex ports eliminate collisions because each device has separate channels for the transmission and receipt of large amounts of data. |
| | Half | Are not sending large amounts of data | No action is required.<br><br>**Important:** Delays due to collisions or switch traffic are usually negligible, but can become a problem if you need to send a lot of data. |
| | | Are sending large amounts of data | Change your module's Duplex setting to Full. See Configure the Module with RSLinx Software on page 48. |
| Autonegotiate Status is | Speed and/or Duplex | Are using a fiber converter | Change your module's Autonegotiate status to None. See Configure the Module with RSLinx Software on page 48.<br><br>**Important:** Fiber links do not support autonegotiation. |
| | | Are not using a fiber converter | No action is required.<br><br>**Important:** Speed and/or Duplex is the default setting.<br><br>Autonegotation enables devices to select the best way to communicate without you having to do any configuring. All devices with an Ethernet speed rating of 100 Mbps are required to support autonegotiation. |
| | None | Are not using a fiber converter | Change your module's Autonegotiate status to Speed and/or Duplex. See Configure the Module with RSLinx Software on page 48. |

3. Review the System Resource Utilization table to evaluate your CPU utilization.

| System Resource Utilization | |
|---|---|
| CPU | 1.60 % |

| If the CPU utilization rate is | Then |
|---|---|
| 0...80% | No action is required.<br><br>**Important:** This is the optimal rate. |
| Greater than 80% | • Take steps to reduce your CPU utilization. See Internet Group Multicast Protocol on page 157.<br>• Adjust your connection's requested packet interval (RPI).<br>• Reduce the number of devices connected to your module.<br>**Important:** Your EtherNet/IP communication module can function at 100% CPU capacity, but at or near this rate, you run the risk of CPU saturation and performance problems. |

4. Review the Missed field in the I/O Packet Counter Statistics table.

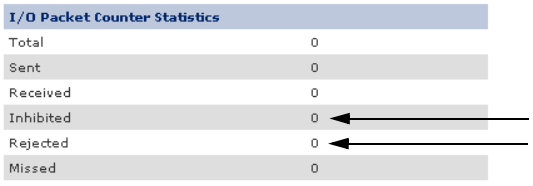


| I/O Packet Counter Statistics | |
|---|---|
| Total | 0 |
| Sent | 0 |
| Received | 0 |
| Inhibited | 0 |
| Rejected | 0 |
| Missed | 0 |

This field shows how many I/O packets have been missed. Your EtherNet/IP communication module may lose I/O packets due to:

- packets being produced faster than the connection's requested packet interval (RPI). This happens for change-of-state connections or a new consumer requesting a faster RPI than the first consumer.
- a packet having been received out of sequence.

a. If more than zero packets have been recorded as lost, review the Inhibited and Rejected fields in the I/O Packet Counter Statistics table.



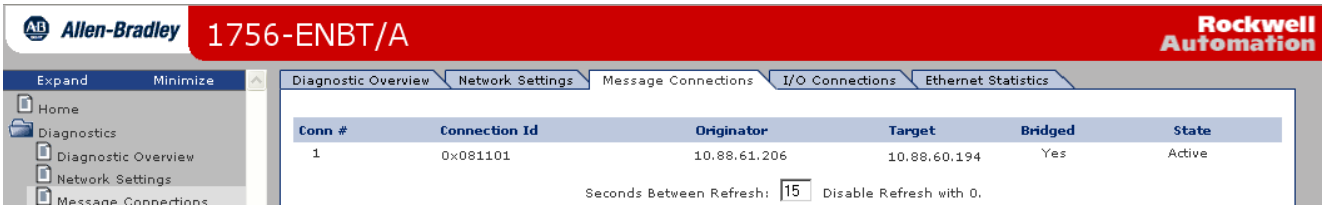
| I/O Packet Counter Statistics | |
|---|---|
| Total | 0 |
| Sent | 0 |
| Received | 0 |
| Inhibited | 0 |
| Rejected | 0 |
| Missed | 0 |

| If | Then |
|---|---|
| There are more than zero inhibited I/O packets | Reconfigure your module to produce packets no more quickly than the connection's RPI. See Configure Your Module with RSLogix 5000 Software on page 50. |
| There are more than zero rejected I/O packets | View the Message Connections diagnostic web page to confirm what, if any, connections are closed. See Message Connections on page 152.<br><br>**Important:** If more than four I/O packets have been rejected, your module has probably lost its connection. |
| | There are possibly duplicate module IP addresses.<br><br>Observe your module's status indicators and take recommended actions. See Status Indicators on page 167.<br><br>**Important:** Many EtherNet/IP communication modules can detect duplicate IP addresses. See Duplicate IP Address Detection on page 51. |
| | A packet has possibly been received out of sequence and rejected because the previous packet was inhibited.<br><br>Reconfigure your module to produce packets no more quickly than the connection's RPI. See Configure Your Module with RSLogix 5000 Software on page 50. |

## Message Connections

If you want to check the status of your module connections, click the Message Connections tab.

The Message Connections diagnostic web page appears.



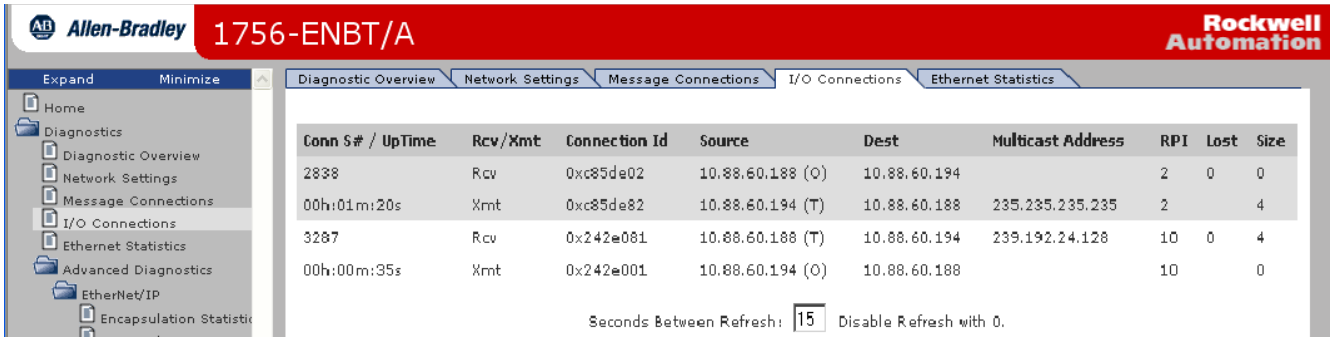

These are the four connection states:

- Active
- Closing
- Faulted
- Reserved

## I/O Connections

If you want to check the status of your module's I/O connections, click the I/O Connections tab.

The I/O Connections diagnostic web page appears.




The Lost column shows the number of I/O packets that were not received.

**IMPORTANT** To troubleshoot lost I/O packets, review the I/O Packet Counter Statistics table in the Diagnostic Overview tab. See page 151.

## Ethernet Statistics

Your EtherNet/IP communication module may experience intermittent network connectivity due to:

- a duplex mismatch.
- electrical noise induced into a cable or resulting from a Logix/switch ground potential difference.
- bad hardware, such as a cable or switch part.

Before troubleshooting this problem, familiarize yourself with these Ethernet statistics, or media counters.

**Ethernet Media Counters**

| Media Counter | Definition |
|---|---|
| Alignment Errors | A frame containing bits that do not total an integral multiple of eight.<br><br>Alignment errors often result from:<br><br>• starting or stopping of module.<br>• MAC-layer packet formation problems.<br>• cabling problems that corrupt or eliminate data.<br>• packets passing through more than two cascaded multiport transceivers. |
| FCS Errors | A frame containing eight bits, at least one of which has been corrupted.<br><br>FCS errors often result from:<br><br>• starting or stopping the module.<br>• cabling problems that corrupt data.<br>**Important:** Even though the acceptable Ethernet bit-error rate is 1 in 108, the typical rate is 1 in 1012 or better. |
| Single Collisions | The number of outgoing packets that encountered only one collision during transmission. |
| Multiple Collisions | The number of outgoing packets that encountered 2...15 collisions during transmission. |
| SQE Test Errors | A test to detect the collision-present circuit between a transceiver and a network interface card (NIC).<br><br>**Important:** Because most NICs now have an integrated transceiver, the SQE test is unnecessary. Ignore this media counter. |
| Deferred Transmissions | The number of outgoing packets whose transmission is deferred because the network is busy when the first attempt is made to send them.<br><br>**Important:** The module will only defer the first attempt to transmit a packet. After the first attempt, the module will transmit the packet without checking. However, if the network is still busy, a collision will be recorded. |
| Late Collisions | The number of times two devices transmit data simultaneously.<br><br>Neither device detects a collision because the time it takes to send the signal from one end of the network to the other exceeds the time needed to put the entire packet on the network. Consequently, neither device senses the other's transmission until the entire packet is out on the network.<br><br>Late collisions often result from:<br><br>• excessive network segment length.<br>• repeaters between devices.<br>**Important:** Large and small packets can be affected by late collisions. However, the transmitter cannot detect late collisions between small packets. Consequently, a network that experiences measurable late collisions between large packets will also lose small packets. |
| Excessive Collisions | The number of frames that experience 16 consecutive collisions. |
| MAC Transmit Errors | The number of frames for which transmission via a particular interface fails due to an internal MAC sublayer transmission error.<br><br>**Important:** MAC transmit errors are only counted if either late collisions, excessive collisions, or carrier sense errors are not counted. |

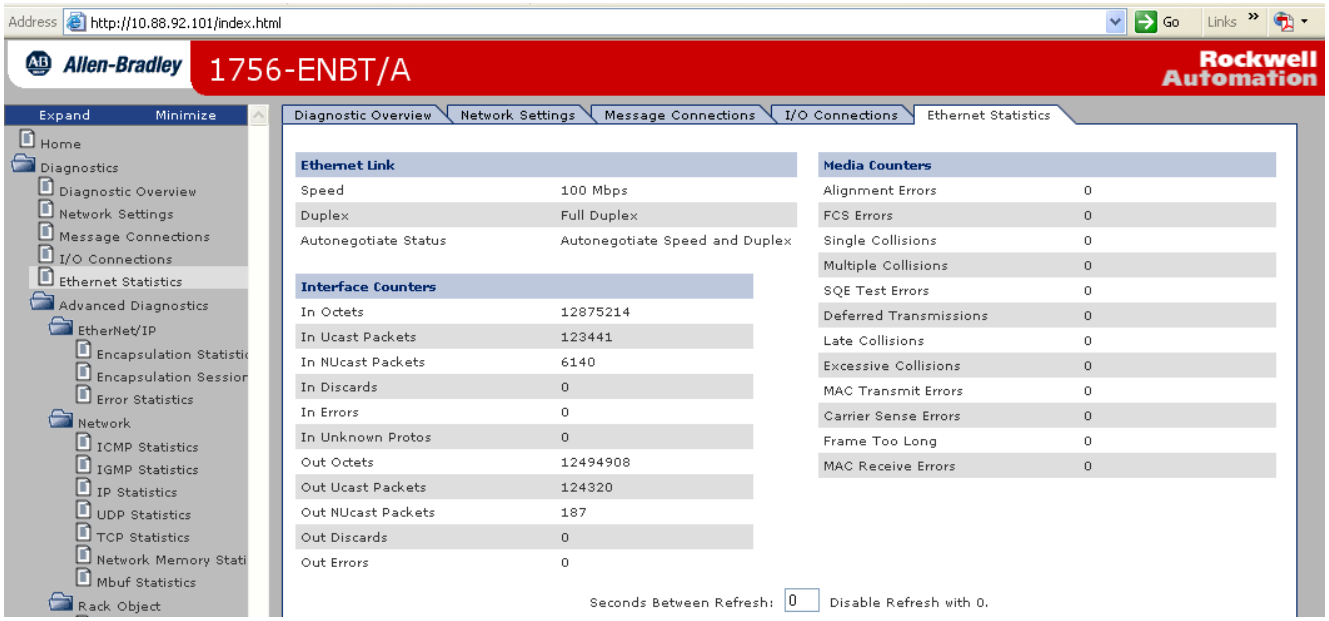
### Ethernet Media Counters

| Media Counter | Definition |
|---|---|
| MAC Receive Errors | The number of frames for which reception via a particular interface fails due to an internal MAC sublayer transmission error.<br><br>**Important:** MAC receive errors are only counted if either the frame too long count, alignment errors, or FCS errors are not counted. |
| Carrier Sense Errors | Carrier sense errors fall into these categories:<br>• No Carrier Sense Present - The number of times the carrier is not present when a transmission starts.<br>• Carrier Sense Lost - The number of times the carrier is lost during a transmission.<br>Carrier sense errors usually indicate a problem with a cable on the Ethernet infrastructure. |
| Frame Too Long | The number of incoming packets that exceed the maximum Ethernet packet size. |

To troubleshoot intermittent Ethernet connectivity, perform this procedure.

1. Click the Ethernet Statistics tab.

   The Ethernet Statistics diagnostic web page appears.



2. Review the values in the Media Counters table.

| If | Then |
|---|---|
| Any media counters are greater than zero | You need to investigate further. |
| These errors are counted:<br>· Alignment<br>· FCS<br>· Carrier Sense | A duplex mismatch exists between your EtherNet/IP module and the switch port.<br>To clear the duplex mismatch:<br>a. Configure the EtherNet/IP module and the corresponding Ethernet switch port for a forced operation, not autonegotiation. See Configure the Module with RSLinx Software on page 48.<br>b. Verify that the firmware revision of your Logix controller and switch or converter are identical.<br>c. If the revisions are not identical, replace the controller, switch or converter so that they match. |
| Single Collisions or Multiple Collisions are greater than zero | No action is required.<br>**Important:** If two stations attempt to transmit data simultaneously, the packets collide with each other. However, collisions are not errors and do not indicate a network problem. The number of network collisions can vary greatly due to traffic patterns or CPU utilization. Consequently, there is no set range of acceptable collisions for each outgoing packet. Collisions are a normal aspect of Ethernet networking. |
| Late Collisions are greater than zero | a. Check to see if a network segment is too long.<br>b. Remove repeaters from between devices. |
| Excessive Collisions are greater than zero | Calculate your network's typical rate of excessive collisions and decide whether the rate of packet loss will affect your network's performance.<br>**Important:** Excessive collisions indicate that your network has become congested. For each collision after the sixteenth, your network drops a packet. |
| MAC Transit Errors are greater than zero | No action is required. |
| Frame Too Long is greater than zero | Limit the size of your tags to ≤500 bytes. See Tag Guidelines for Produced or Consumed Data on page 95. |

## Switch Considerations

To help troubleshoot your EtherNet/IP network, you must use a managed switch. Some of the important features in a managed switch include:

- Internet Group Multicast Protocol (IGMP) snooping.
- support for Virtual Local Area Networks (VLAN).
- port mirroring.

**IMPORTANT** Use a switch equipped with wire-speed switching fabric. The switch fabric is a measure of the maximum traffic that a switch can handle without dropping a packet and without storing a packet in memory. Wire-speed switching fabric refers to a switch that can handle the maximum data rate of the network on each of its ports.

Switches are typically rated in Gbps. For a 10-port switch connected to EtherNet/IP products, the maximum data rate needed is typically 100...200 MB/s. Therefore, a 10-port-switch rated at least 1 GB/s should be adequate for an EtherNet/IP application.

### Internet Group Multicast Protocol

EtherNet/IP implicit (I/O) messaging mostly uses IP multicasting to distribute I/O control data, which is consistent with the CIP produced/consumer model. Most switches retransmit multicast packets and broadcast packets to all ports.

IGMP snooping constrains the flooding of multicast traffic by dynamically configuring switch ports so that multicast traffic is forwarded only to ports associated with a particular IP multicast group. This also helps minimize the CPU utilization rate.

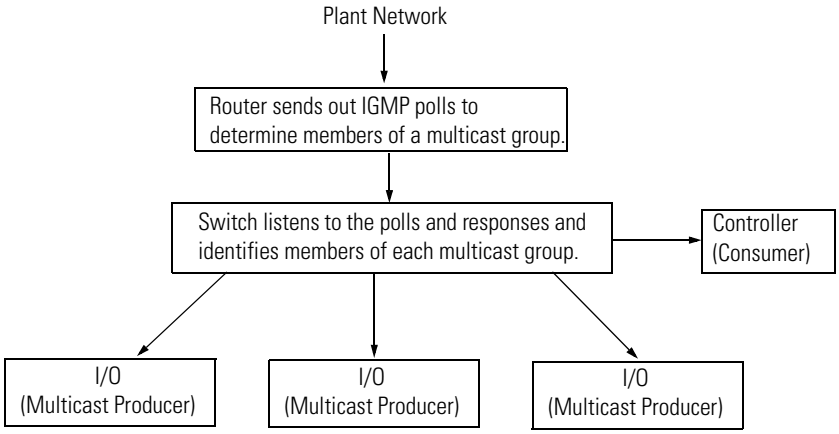
Switches that support IGMP snooping learn which ports have devices that are part of a particular multicast group and only forward the multicast packets to the ports that are part of the multicast group.

**IMPORTANT** Not all switches support the IGMP snooping querier function, that is, snooping. Those that do not support IGMP snooping querier require a router. For switches that do support IGMP snooping, you can configure them to conduct the polling.

IGMP snooping cannot control unicast or broadcast traffic. To learn how to control unicast or broadcast traffic, see Virtual Local Area Networks on page 158.

This example assumes that the switch does not support IGMP snooping querier function, so a router is required.

**IGMP Snooping Example**


Plant Network
Router sends out IGMP polls to determine members of a multicast group.
Switch listens to the polls and responses and identifies members of each multicast group.
Controller (Consumer)
I/O (Multicast Producer)
I/O (Multicast Producer)
I/O (Multicast Producer)

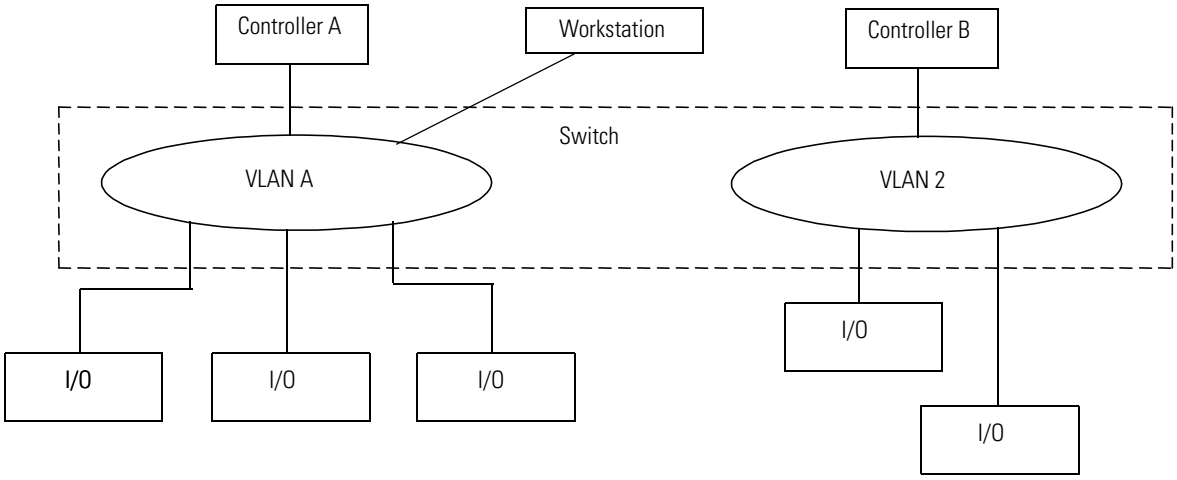
## Virtual Local Area Networks

With a managed switch, you can establish virtual local area networks (VLAN) to segregate various kinds of network traffic and also increase security between your networks. You could create multiple isolated networks so that the traffic from one network does not burden the other network.

As with IGMP snooping, VLAN can control multicast traffic. However, unlike IGMP snooping, VLAN can also control and block:

- unicast traffic.
- broadcast traffic.

**Virtual Local Area Networks (VLAN)**



## Port Mirroring

Select a managed switch that supports port mirroring. With port mirroring, you can direct frames being transmitted on one port to another port for analysis by a traffic analyzer. Besides monitoring your Ethernet media counters, port mirroring enables you to immediately spot anomalies in traffic flow. A traffic analyzer can monitor the traffic on a given port and troubleshoot a problem. Without port mirroring, you cannot see frames on other ports. With hubs this is not an issue because all frames are transmitted out all ports. The effective support and maintenance of Ethernet networks often depends on reliable traffic analysis.

The benefits of port mirroring include:

- monitoring explicit messages between controllers.
- monitoring implicit or I/O traffic.

## Notes:

# USB Serial Communication

## Introduction

This chapter describes how to configure RSLinx software to use a USB port and how you can and cannot flash upgrade firmware via a USB port.


| Topic | Page |
|---|---|
| Configure a Module Via the USB Port | 162 |
| Flash Upgrade Firmware through a USB Port | 165 |

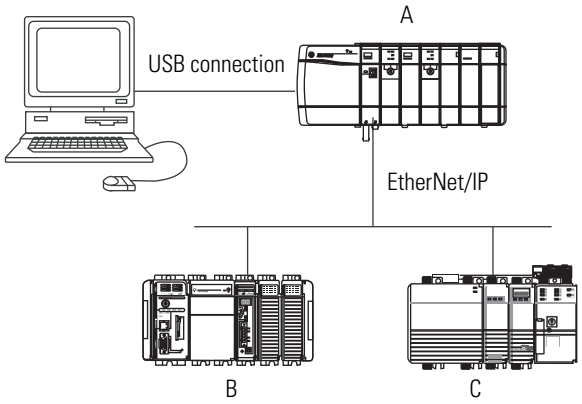

Two EtherNet/IP modules support USB serial communication.

- 1756-EN2F
- 1756-EN2T
- 1756-EN2TR
- 1756-EN2TXT

## Set Up the Hardware

In this example, the controller in the local chassis produces a tag that the Logix5000 controller in the remote chassis consumes. The local controller can also send a MSG instruction to the remote controller.

**Sharing Data and Transferring Messages**




| Item | Description |
|---|---|
| A | Local chassis containing a Logix5000 controller and a 1756-EN2T, 1756-EN2TR, 1756-EN2TXT, or 1756-EN2F module |
| B | Remote chassis containing a Logix5000 controller with an EtherNet/IP connection |
| C | Remote chassis containing Logix5000 controller |

## Configure a Module Via the USB Port

**WARNING**

The USB port is intended for temporary local programming purposes only and not intended for permanent connection. If you connect or disconnect the USB cable with power applied to this module or any device on the USB network, an electrical arc can occur. This could cause an explosion in hazardous location installations. A Samtec Inc. RSP-119350 USB cable is required to maintain hazardous location certifications.

**ATTENTION**

Be sure that power is removed or the area is nonhazardous before proceeding

The module has a USB device port. To use the USB port, you must have RSLinx software, version 2.51 or later, installed on your computer. Use a USB cable to connect your computer to the USB port. The connection lets you download programs to controllers and configure other devices, which are accessible by the module, directly from your computer.

**IMPORTANT**

The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.

## Set Up a USB Driver

To configure RSLinx software to use a USB port, you need to first set up a USB driver. To set up a USB driver, perform this procedure.

1. Connect your EtherNet/IP module to your computer by installing a USB cable in your module's USB port.

   The RSLinx Found New Hardware Wizard dialog box appears.

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
Rockwell Automation USB CIP
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

2. Select Install the Software Automatically.

3. Click Next.

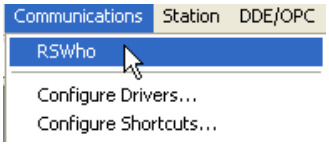
These RSLinx dialog boxes appear consecutively.

Found New Hardware Wizard
Please wait while the wizard installs the software...
Rockwell Automation USB CIP
Setting a system restore point and backing up old files in case your system needs to be restored in the future.
< Back
Next >
Cancel

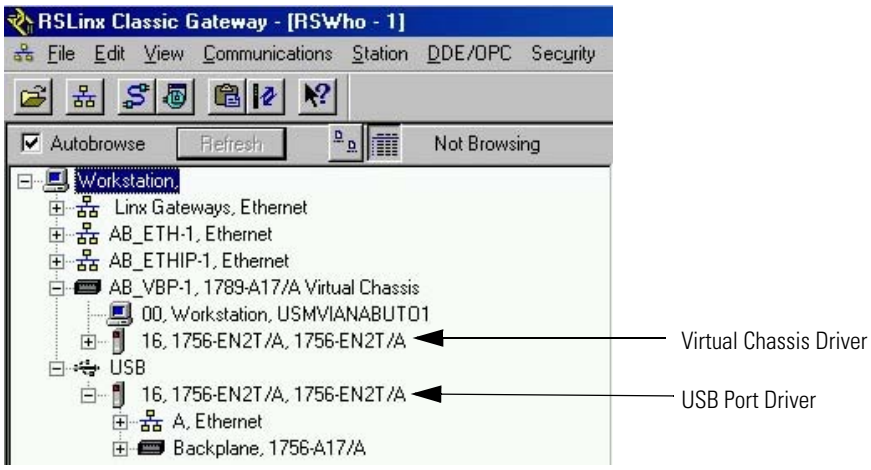
Found New Hardware Wizard
Completing the Found New Hardware Wizard
The wizard has finished installing the software for:
Rockwell Automation USB CIP
Click Finish to close the wizard.
< Back
Finish
Cancel

4. Click Finish to set up your USB driver.

5. In RSLinx software, from the Communications pull-down menu, choose RSWho.



The RSLinx Workstation organizer appears.




Your 1756-EN2T module appears under two different drivers, a virtual chassis and the USB port.

## Flash Upgrade Firmware through a USB Port

**IMPORTANT** Do not simultaneously flash upgrade the firmware for more than one module at a time through a USB port. If you do, one or more of the flash updates may fail in the middle of the upgrade.

## Notes:

# Status Indicators

## Introduction

This appendix provides status indicator descriptions for several communication modules, adapters, and controllers.


| Topic | Page |
|---|---|
| 1756-ENBT EtherNet/IP Module Status Indicators | 169 |
| 1756-EN2F EtherNet/IP Module Status Indicators | 171 |
| 1756-EN2T EtherNet/IP Module Status Indicators | 173 |
| 1756-EN2TR EtherNet/IP Module Status Indicators | 175 |
| 1756-EN2TXT ControlLogix-XT EtherNet/IP Bridge Module Status Indicators | 177 |
| 1769-L23E-QB1B and 1769-L23E-QBFC1B Controllers Status Indicators | 178 |
| 1769-L32E and 1769-L35E Controllers Status Indicators | 183 |
| 1768-ENBT Module Status Indicators | 185 |
| 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP Tap Status Indicators | 187 |
| 1788-ENBT EtherNet/IP Daughtercard Status Indicators | 189 |
| 1734-AENT and 1734-AENTR EtherNet/IP POINT I/O Adapter Status Indicators | 192 |
| 1738-AENTR ArmorPOINT I/O 2-port EtherNet/IP Adapter Status Indicators | 195 |
| 1794-AENT EtherNet/IP FLEX I/O Adapter Status Indicators | 199 |
| 20-COMM-E Module Status Indicators | 201 |
| 22-COMM-E Module Status Indicators | 205 |


Status indicators common to all modules, cards and controllers presented in this chapter include:

- Link Status Indicator (LNK).
- Network Status Indicator (NET).
- Health Status Indicator (OK).

Other important status indicators on some products presented in this chapter include:

- Module Status Indicator (MS).
- Utilization Percent Indicator (U%).
- POINTBus Status Indicator.
- System Power Indicator.
- Field Power Indicator.

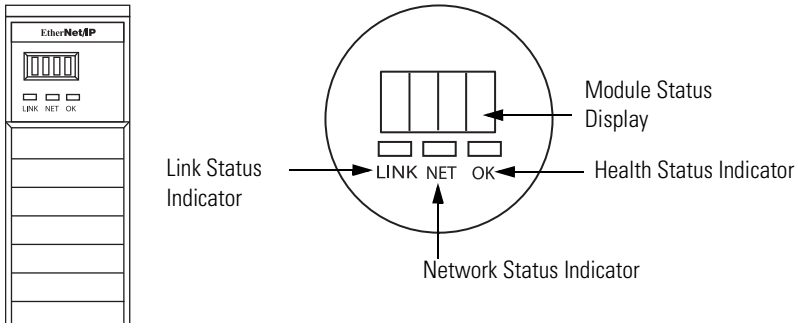
**Status Indicators**

| Status Indicator | Explanation |
|---|---|
| Link Status | Shows whether or not data is being transmitted. |
| Network Status | Shows whether or not a network connection has been established. |
| Network Activity | Shows whether or not data is being transmitted. |
| Health Status | Shows whether power has been applied to the module. |
| Module Status | Shows the state of the module, such as the running of a self test, the updating of firmware, or operating normally without a network connection.<br><br>**Important:** The Module Status Display window displays scrolling messages that identify more specifically the module condition. |
| Utilization Percent | Shows the percentage of available data transmission capacity currently in use.<br><br>**Important**: This indicator is only available on the 1788-ENBT module. |
| POINTBus | Shows whether adapter power has been applied. |
| System Power | Shows whether backplane power has been applied or exceeded. |
| Field Power | Shows whether field power has been applied. |

# 1756-ENBT EtherNet/IP Module Status Indicators

The 1756-ENBT EtherNet/IP communication module has several status indicators.

**1756-ENBT EtherNet/IP Module Status Indicators**




**Network (NET) Status Indicator**

| Indicator condition | Status | Description |
|---|---|---|
| Off | | The module is not powered, or does not have an IP address.<br><br>Follow the corrective action below. |
| Flashing green | IP Address/Mask/Gateway Config Invalid | The controller has an IP address, but no CIP connections are established.<br><br>If no connections are configured, this is normal operation. No action is required.<br><br>If connections are configured, check connection originator for connection error code. |
| Green | XXX.XXX.XXX.XXX OK | The module has an IP address and at least one established connection. This is normal operation and no action is required. |
| Flashing red | Class *x* Connection Timeout | One or more of the connections in which the module is the target has timed out. Reestablish the connection. |
| Red | Duplicate IP XX:XX of xx:xx:xx is using the IP address of this module | A duplicate IP address has been detected. Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |

If the **NET status indicator is off**, take the following actions.

1. Verify there is chassis power.
2. Verify that the module is completely inserted into the chassis and backplane.
3. Make sure the module has been configured.

**Link Status Indicator**

| Indicator condition | Status | Description |
|---|---|---|
| Off | Link lost | No data is being transmitted. Check to see if any cables are disconnected. |
| Green | XXX.XXX.XXX.XXX OK | The module is ready to communicate. No action is required. |
| Flashing green | | Data is being transmitted. No action is required. |

**OK Status Indicator**

| Indicator condition | Status | Description |
|---|---|---|
| Off | | The module does not have 24V DC power.<br><br>Follow the corrective action below. |
| Flashing green | BOOTP - XX:XX:XX:XX:XX:XX or xx:xx:xx:xx:xx:xx<br>DHCP - XX:XX:XX:XX:XX:XX | The module is not configured. Configure the module. |
| Green | XXX.XXX.XXX.XXX OK | The module is operating correctly. No action is required. |
| Flashing red | Duplicate IP XX:XX:XX:XX:XX:XX | A device with the Ethernet MAC address of xx:xx:xx:xx:xx:xx is using the IP address of this module.<br><br>Make sure that the the IP address assigned to this module is not the same as that for any other device already on the network. |
| | Flash Update | A firmware update is in progress. No action is required. |
| Red | Severe Fault | An unrecoverable fault has been detected.<br><br>Follow the corrective action below. |
| Flashing red/green | Rev %d.%d.%d | The module is performing a self test while it is being started. No action is required. |

If the **OK status indicator is off**, take the following actions.

1. Verify that there is chassis power.
2. Verify that the module is completely inserted into the chassis and backplane.

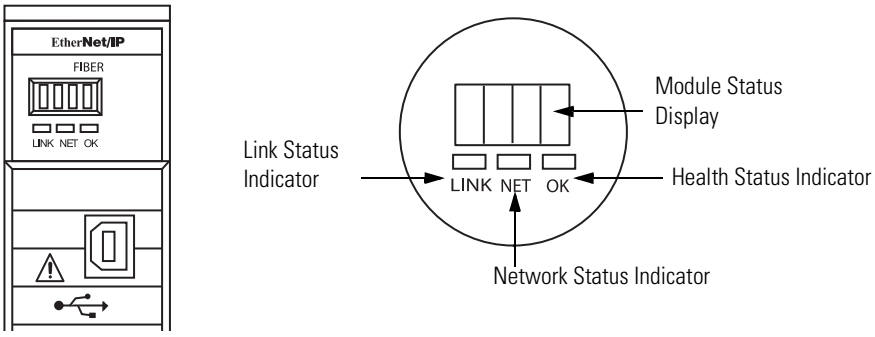
If the **OK indicator is red**, take the following actions.

1. Cycle power to the module.
2. If this does not clear the fault, replace the module.

# 1756-EN2F EtherNet/IP Module Status Indicators

The 1756-EN2F EtherNet/IP communication module has several status indicators.

**1756-EN2F EtherNet/IP Fiber Module Status Indicators**




**Network (NET) Status Indicator**

| Indicator condition | Status | Description |
|---|---|---|
| Off | | The module is not powered, or does not have an IP address.<br><br>Follow the corrective action below. |
| Flashing green | IP Address/Mask/Gateway Config Invalid | The controller has an IP address, but no CIP connections are established.<br><br>If no connections are configured, this is normal operation. No action is required.<br><br>If connections are configured, check connection originator for connection error code. |
| Green | XXX.XXX.XXX.XXX OK | The module has an IP address and at least one established connection. No action is required. |
| Flashing red | Class *x* Connection Timeout | One or more of the connections in which the module is the target has timed out. Reestablish the connection. |
| Red | Duplicate IP XX:XX of xx:xx:xx is using the IP address of this module | A duplicate IP address has been detected. Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |

If the **NET status indicator is off**, take the following actions.

1. Verify there is chassis power.
2. Verify that the module is completely inserted into the chassis and backplane.
3. Make sure the module has been configured with a valid IP address.

**Link Status Indicator**

| Indicator condition | Status | Description |
|---|---|---|
| Off | Link lost | No data is being transmitted. Check to see if any cables are disconnected. |
| Green | XXX.XXX.XXX.XXX OK | The module is ready to communicate. No action is required. |
| Flashing green | | Data transmission in progress. No action is required. |

**OK Status Indicator**

| Indicator condition | Status | Description |
|---|---|---|
| Off | | The module does not have 24V DC power.<br><br>Follow the corrective action below. |
| Flashing green | BOOTP - XX:XX:XX:XX:XX:XX or xx:xx:xx:xx:xx:xx<br>DHCP - XX:XX:XX:XX:XX:XX | The module is not configured. Configure the module. |
| Green | XXX.XXX.XXX.XXX OK | The module is operating correctly. No action is required. |
| Flashing red | Duplicate IP XX:XX:XX:XX:XX:XX | A device with the Ethernet MAC address of xx:xx:xx:xx:xx:xx is using the IP address of this module.<br><br>Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |
| | Flash Update | A firmware update is in progress. No action is required. |
| Red | Severe Fault | An unrecoverable fault has been detected.<br><br>Follow the corrective action below. |
| Flashing red/green | Rev %d.%d.%d | The module is performing a self test while it is being started. No action is required. |

If the **OK status indicator is off**, take the following actions.

1. Verify that there is chassis power.
2. Verify that the module is completely inserted into the chassis and backplane.

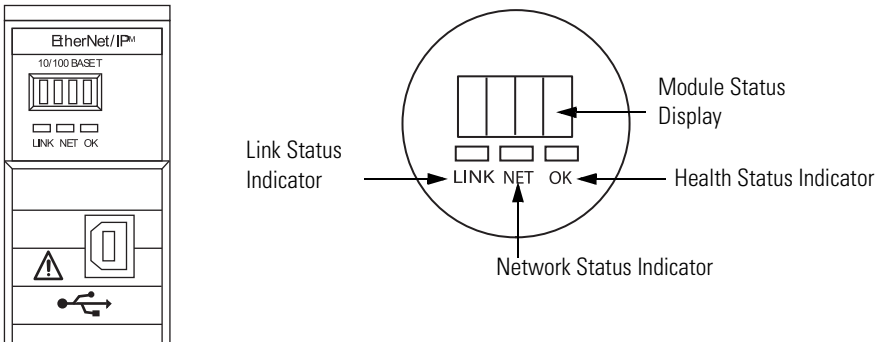
If the **OK status indicator is red**, take the following actions.

1. Cycle power to the module.
2. If this does not clear the fault, replace the module.

# 1756-EN2T EtherNet/IP Module Status Indicators

The 1756-EN2T EtherNet/IP communication modules have several status indicators.

**1756-EN2T EtherNet/IP Module Status Indicators**




**Network (NET) Status Indicator**

| Indicator Condition | Status | Description |
|---|---|---|
| Off | | The module is not powered, or does not have an IP address.<br><br>Follow the corrective action below. |
| Flashing green | IP Address/Mask/Gateway Config Invalid | The controller has an IP address, but no CIP connections are established.<br><br>If no connections are configured, this is normal operation. No action is required.<br><br>If connections are configured, check connection originator for connection error code. |
| Green | XXX.XXX.XXX.XXX OK | The module has an IP address and at least one established connection. No action is required. |
| Flashing red | Class *x* Connection Timeout | One or more of the connections in which the module is the target has timed out. Reestablish the connection. |
| Red | Duplicate IP XX:XX of xx:xx:xx is using the IP address of this module | A duplicate IP address has been detected.<br><br>Make sure that the the IP address assigned to this module is not the same as that for any other device already on the network. |

If the **NET status indicator is off**, take the following actions.

1. Verify there is chassis power.
2. Verify that the module is completely inserted into the chassis and backplane.
3. Make sure the module has been configured.

**Link Status Indicator**

| Indicator Condition | Status | Description |
|---|---|---|
| Off | Link lost | No data is being transmitted. Check to see if any cables are disconnected. |
| Green | XXX.XXX.XXX.XXX OK | The module is ready to communicate. No action is required. |
| Flashing green | | Data transmission is in progress. No action is required. |

**OK Status Indicator**

| Indicator Condition | Status | Description |
|---|---|---|
| Off | | The module does not have 24V DC power.<br><br>Follow the corrective action below. |
| Flashing green | BOOTP - XX:XX:XX:XX:XX:XX or xx:xx:xx:xx:xx:xx<br>DHCP - XX:XX:XX:XX:XX:XX | The module is not configured. Configure the module. |
| Green | XXX.XXX.XXX.XXX OK | The module is operating correctly. No action is required. |
| Flashing red | Duplicate IP XX:XX:XX:XX:XX:XX | A device with the Ethernet MAC address of xx:xx:xx:xx:xx:xx is using the IP address of this module.<br><br>Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |
| | Flash Update | A firmware update is in progress. No action is required. |
| Red | Severe Fault | An unrecoverable fault has been detected.<br><br>Follow the corrective action below. |
| Flashing red/green | Rev %d.%d.%d | The module is performing a self test while it is being started. No action is required. |

If the **OK status indicator is off**, take the following actions.

1. Verify that there is chassis power.
2. Verify that the module is completely inserted into the chassis and backplane.

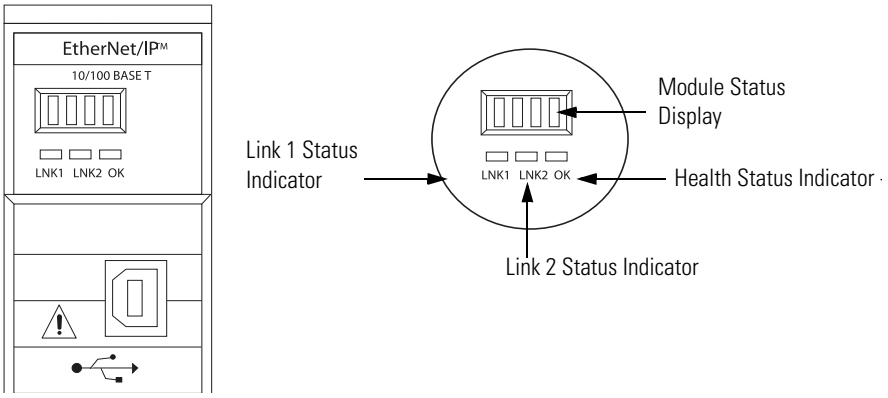
If the **OK status indicator is red**, take the following actions.

1. Cycle power to the module.
2. If this does not clear the fault, replace the module.

# 1756-EN2TR EtherNet/IP Module Status Indicators

The 1756-EN2TR EtherNet/IP communication module has several status indicators.

**1756-EN2TR EtherNet/IP Module Status Indicators**




**Link Status Indicators**

| Indicator | Status | Description |
|---|---|---|
| LNK1, LNK2 | Off | No link, or port administratively disabled, or port disabled due to rapid ring faults (LNK2). |
| | Green | One of these conditions exists:<br>• A link exists on the port<br>• The ring network is operating normally on active ring supervisor (LNK2)<br>• Ring partial network fault detected on active ring supervisor (LNK2) |
| | Flashing green | Activity exists on the port |

**OK Status Indicator**

| | | |
|---|---|---|
| OK | Off | Module does not have 24V DC power. Verify that there is chassis power and the module is completely inserted into chassis and backplane. |
| | Flashing green | Module is not configured. |
| | Green | Module is operating correctly. |
| | Flashing red | Module detected a recoverable fault. A configuration error may have caused the fault. |
| | Red | Recycle power to the module. If this does not clear the fault, replace the module. Check the module configuration and, if necessary, reconfigure the module. |
| | Red and alphanumeric display scrolls 'Image Update Needed' | The main firmware image needs to be updated. Follow the corrective action below. |
| | Flashing red and green | Module performing power-up self-test. Wait for the module to complete powering up and performing self-test. |

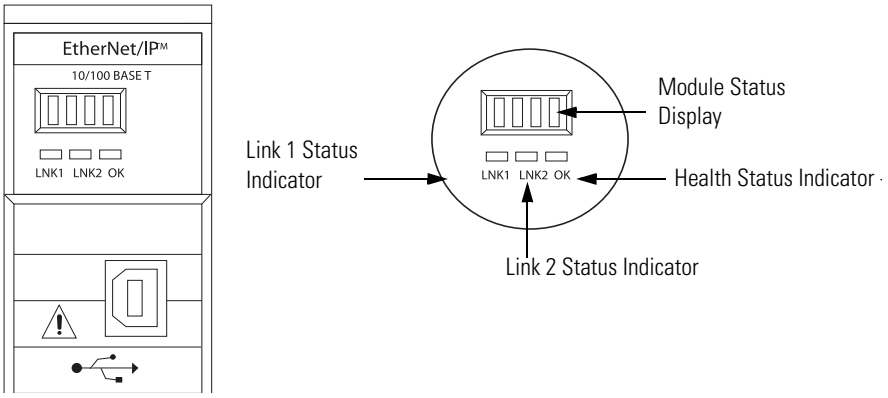
If the **OK status indicator Red and alphanumeric display scrolls 'Image Update Needed'**, take the following actions.

1. Update the firmware image.
2. Once the image is updated, recycle power.
3. If this does not clear the fault, replace the module.

# 1756-EN2TXT ControlLogix-XT EtherNet/IP Bridge Module Status Indicators

The 1756-EN2TXT EtherNet/IP communication module has several status indicators.

### 1756-EN2TXT EtherNet/IP Module Status Indicators




**NET Status Indicators**

| Indicator | Status | Description |
|---|---|---|
| Link | Off | The module is not ready to communicate. Verify that the module is on. |
| | Green | The module is ready to communicate. |
| | Flashing green | The module is communicating over the network. |

**NET Status Indicators**

| Indicator | Status | Description |
|---|---|---|
| NET | Off | The module is not powered. Verify that there is chassis power and that the module is completely inserted into the chassis and backplane.<br><br>The module does not have a valid IP address. Make sure the module has been configured with a valid IP address. |
| | Green | The module has an IP address and at least one established connection. |
| | Flashing green | The module has an IP address, but has no established connections. |
| | Red | The module is attempting to use an IP address already in use on the network. Assign a unique IP address to the module. |
| | Flashing red | One or more of the connections in which the module is the target has timed out. |

**OK Status Indicators**

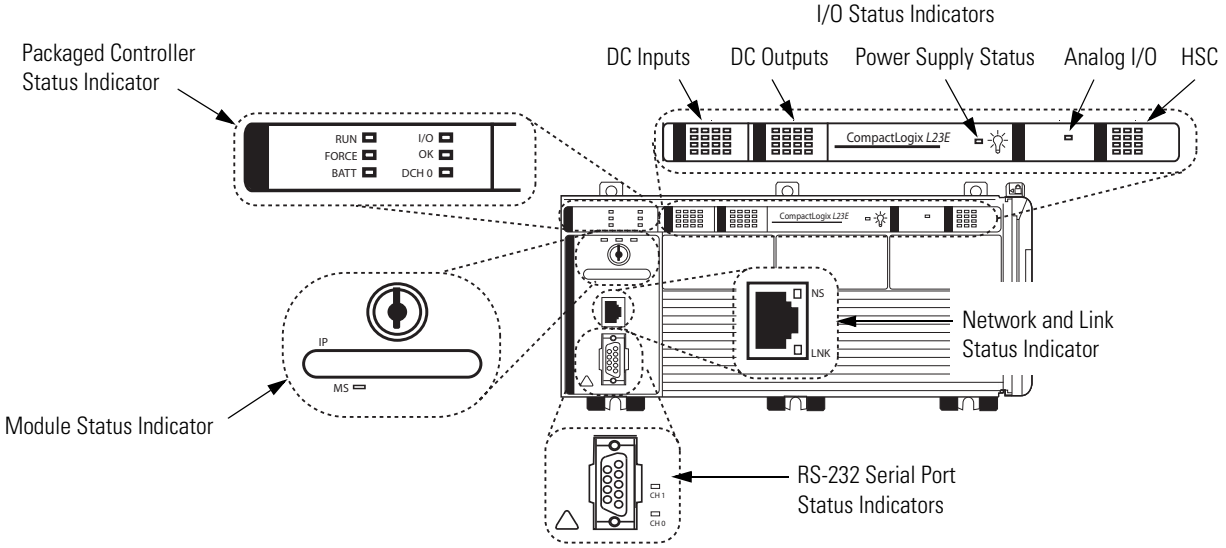
| Indicator | Status | Description |
|---|---|---|
| OK | Off | Verify that the module has 24V DC chassis power and that the module is completely inserted into chassis and backplane. |
| | Green | The module is operating correctly. |
| | Flashing green | The module is not configured. |
| | Red | The module detected an unrecoverable fault. Cycle power to the module. If this does not clear the fault, replace the module. |
| | Flashing red | The module detected a recoverable fault. A configuration error may have caused the fault. Check the module configuration. If necessary, reconfigure the module. |
| | Red and alphanumeric display scrolls 'Image Update Needed' | Update the firmware image. Once the image is updated, cycle power. If this does not clear the fault, replace the module. |
| | Flashing red and green | The module is performing a power-up self-test. |

## 1769-L23E-QB1B and 1769-L23E-QBFC1B Controllers Status Indicators

The 1769-L23E-Q1B and 1769-L23E-QBFC1B CompactLogix controllers have several status indicators.

**TIP** When power is first applied to the controller, the OK, NS, MS, and LNK status indicators display a complex sequence of varying red and green states. This sequence indicates the power-up self test and takes approximately 1…2 minutes for the packaged controller to complete.

**1769-L2x CompactLogix Controller Status Indicators**



**Packaged Controller Status Indicators**

| Indicator | Status | Description |
|---|---|---|
| RUN | Off | The packaged controller is in program or test mode. |
| | Steady green | The packaged controller is in run mode. |
| FORCE | Off | Either:<br>• No tags contain I/O force values.<br>• I/O forces are inactive (disabled). |
| | Steady amber | Either:<br>• I/O forces are active (enabled).<br>• I/O forces values may or may not exist. |
| | Flashing amber | One or more input or output addresses have been forced to an On or Off condition, but the forces have not been enabled. |
| BATT | Off | The battery supports memory. |
| | Steady red | The battery is either:<br>• not installed.<br>• 95% dischared and should be replaced. |
| I/O | Off | Either:<br>• There are no devices in the I/O configuration of the packaged controller.<br>• The packaged controller does not contain a project. |
| | Steady green | The packaged controller is communicating with all the devices in its I/O configuration. |
| | Flashing green | One or more devices in the I/O configuration of the packaged controller are not responding. |
| | Flashing red | Either:<br>• The packaged controller is not communicating with any devices.<br>• The packaged controller is faulted. |

### Packaged Controller Status Indicators

| Indicator | Status | Description |
|---|---|---|
| OK | Off | No power is applied. |
| | Flashing red | One of the following conditions exists:<br>• The packaged controller requires a firmware update.<br>• A major recoverable fault occurred on the packaged controller. To clear the fault, perform this procedure.<br>• Turn the packaged controller keyswitch from PROG to RUN to PROG.<br>• Go online with RSLogix 5000 software.<br>• A nonrecoverable major fault occurred on the packaged controller. In this case, the packaged controller:<br>a. OK indicator initially displays steady red.<br>b. Resets, clearing the project from memory.<br>c. Sets the OK indicator to flashing red.<br>d. Produces a major recoverable fault.<br>e. Generates a fault code in the RSLogix 5000 project.<br>The fault code displayed in RSLogix 5000 software and the subsequent fault recovery method depends upon your system. |
| | Steady red | Upon power-up, the OK indicator is steadily red for a few moments. This is normal behavior and is not a fault.<br>If the OK indicator is steadily red for more than a few moments or changes to steadily red while in use, then a nonrecoverable major fault has occurred and project memory has been cleared.<br>To recover from a major fault, cycle power to the packaged controller, re-download the project, and put the packaged controller in Run mode.<br>If the OK indicator remains steadily red, contact your Rockwell Automation representative or local distributor. |
| | Steady green | The packaged controller is OK. |
| | Flashing green | The packaged controller is storing or loading a project to or from nonvolatile memory. |

**Packaged Controller Status Indicators**

| Indicator | Status | Description |
|---|---|---|
| MS | Off | The packaged controller does not have power. Check the controller power supply. |
| | Flashing green | The port is in standby mode; it does not have an IP address and is operating in BOOTP mode. Verify that the BOOTP server is running. |
| | Steady green | The port is operating correctly. No action is required. |
| | Steady red | The packaged controller is holding the port in reset or the packaged controller has faulted. Clear the fault. If the fault will not clear, replace the packaged controller. |
| | | The port is performing its power-up self test. No action is required. |
| | | A non-recoverable fault has occurred. Cycle power to the controller. If the fault will not clear, replace the packaged controller. |
| | Flashing red | The port firmware is being uploaded. No action is required. |
| NET | Off | The port is not initialized; it does not have an IP address and is operating in BOOTP mode. Verify that the BOOTP server is running. |
| | Flashing green | The port has an IP address, but no CIP connections are established.<br><br>If no connections are configured, no action is required.<br><br>If connections are configured, check connection originator for connection error code. |
| | Steady green | The port has an IP address and CIP connections (Class 1 or Class 3) are established. No action is required. |
| | Steady red | Duplicate IP adddress has been detected. Verify that all IP addresses are unique. |
| | Flashing red/green | The port is performing its power-up self test. No action is required. |
| LNK | Off | The port is not connected to a powered Ethernet device. Therefore, the controller cannot communicate over an Ethernet network.<br><br>Verify that all Ethernet cables are connected.<br><br>Verify that Ethernet switch is powered. |
| | Flashing green | The port is performing its power-up self test. No action required. |
| | | The port is communicating on Ethernet. No action required. |
| | Steady green | The port is connected to a powered Ethernet device. Therefore, the controller can communicate over an Ethernet network. No action required. |
| CH0 | Off | Channel 0 configuration differs from the default serial configuration. |
| | Steady green | Channel 0 has the default serial configuration. |
| CH1 | Off | No RS-232 activity. |
| | Flashing green | RS-232 activity. |

## I/O Status Indicators

| Indicator | Description |
|---|---|
| Digital Inputs | There is one status indicator for each digital input point of the CompactLogix packaged controller. When an input is ON, the corresponding input light is on (amber). |
| Digital Outputs | There is one status indicator for each digital output point of the CompactLogix packaged controller. When an output is ON, the corresponding output light is on (amber). |
| Analog I/O | The analog I/O have one status indicator - the OK status indicator. If the indicator is green, the analog I/O have power, have passed internal diagnostics, and are communicating properly. If analog I/O OK indicator is off, a fault is present. |
| High Speed Counter | The high-speed counters have 12 status indicators. Use this table to interpret the HSC status indicators. |

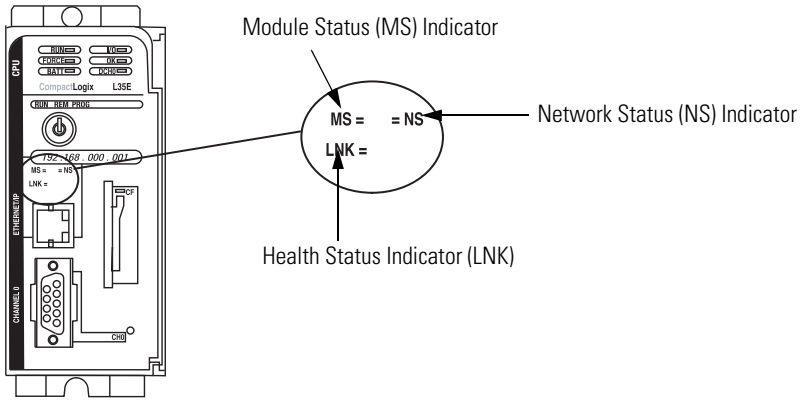
**I/O Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| 0, 1, 2, and 3 | Amber | The corresponding output is ON. |
| A0, A1, B0, B1, Z0 and Z1 | Amber | The corresponding input is ON. |
| FUSE | Red | An overcurrent condition is present. |
| OK | Off | No power to the High Speed Counter. |
| | Flashing red, brief | The HSC is testing itself; this usually occurs at start-up. |
| | Steady green | The HSC is operating normally. |
| | Flashing green | The HSC is in Run mode. |
| | Steady red | A fault has occurrred. |
| | Flashing red, continuous | An HSC configuration error exists. |

# 1769-L32E and 1769-L35E Controllers Status Indicators

The 1769-L32E and 1769-L35E CompactLogix controllers have several status indicators.

**1769-L3*xx* CompactLogix Controller Status Indicators**




**Status Indicators**

| Indicator | Status | Description |
|---|---|---|
| MS | Off | The controller has no power. Check the controller power supply. |
| | Flashing green | The controller does not have an IP address and is operating in BOOTP mode. Verify that the BOOTP server is running. |
| | Green | The controller is operating correctly. No action is required. |
| | Red | The controller is holding the port in reset or the controller is faulted. Follow the corrective action below. |
| | | The controller is performing a self test while it is being started. No action is required. |
| | | An unrecoverable fault has occurred. Follow the corrective action below. |
| | Flashing red | A duplicate IP address has been detected. Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |
| | | The controller firmware is being updated. No action is required. |
| NS | Off | The controller does not have an IP address and is operating in BOOTP mode. Verify that the BOOTP server is running. |
| | Flashing green | The controller has an IP address, but no CIP connections are established. Follow the corrective action below. |
| | Green | The controller has an IP address and CIP connections (Class 1 or Class 3) are established. No action is required. |
| | Red | A duplicate IP address has been detected. Make sure that the IP address assigned to this module is not the same as that for any other device already on the network. |
| | Flashing red/green | The controller is performing a self test while it is being started. No action is required. |

**Status Indicators**

| Indicator | Status | Description |
|---|---|---|
| LNK | Off | The port is not connected to a powered Ethernet device. The controller cannot communicate over an Ethernet network. Follow the corrective action below. |
| | Flashing green | The controller is performing a self test while it is being started. No action is required. |
| | | The controller is communicating on an Ethernet network. No action is required. |
| | Green | The port is connected to a powered Ethernet device. The controller can communicate over an Ethernet network. No action is required. |

If the **MS status indicator is red**, take the following actions.

1. Clear the controller fault or cycle power to the controller.
2. If the fault will not clear, replace the controller.

If the **NS status indicator is flashing green**, take the following actions.

1. If no connections are configured, this is normal, and no action is required.
2. If connections are configured, check connection originator for connection error code.

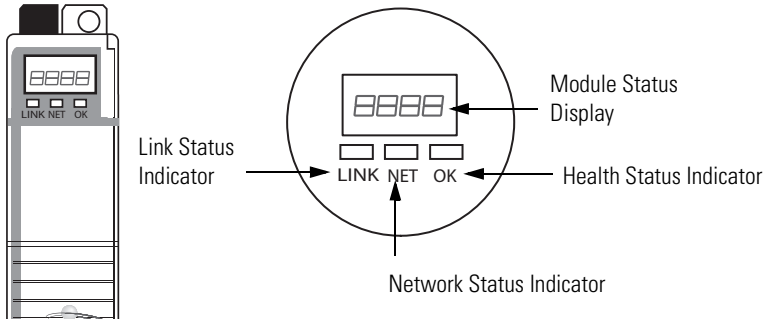
If the **LNK status indicator is green**, take the following actions.

1. Verify that all Ethernet cables are connected.
2. Verify that Ethernet switch is powered.

## 1768-ENBT Module Status Indicators

The 1768-ENBT CompactLogix EtherNet/IP communication module has several status indicators.

**1768-ENBT EtherNet/IP Module Status Indicators**




**Network (NET) Status Indicator**

| Indicator Condition | Status | Description |
|---|---|---|
| Off | | The module is not powered, or does not have an IP address.<br><br>Follow the corrective action below. |
| Flashing green | Controller Comm Problem | The controller has an IP address, but no CIP connections are established.<br><br>If no connections are configured, this is normal operation. No action is required.<br><br>If connections are configured, check the connection originator for a connection error code. |
| Green | XXX.XXX.XXX.XXX OK | The module has an IP address and at least one established connection. No action is required. |
| Flashing red | Class *x* Connection Timeout | One or more of the connections in which the module is the target has timed out. Reestablish the connection. |
| Red | Duplicate IP XX:XX of xx:xx:xx is using the IP address of this module | A duplicate IP address has been detected.<br><br>Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |

If the **NET status indicator is off**, take the following actions.

1. Verify there is chassis power.
2. Verify that the module is completely inserted into the chassis and backplane.
3. Make sure the module has been configured.

**Link Status Indicator**

| Indicator Condition | Status | Description |
|---|---|---|
| Off | Link lost | No data is being transmitted. Check to see if any cables are disconnected. |
| Green | XXX.XXX.XXX.XXX OK | The module is ready to communicate. No action is required. |
| Flashing green | | Data is being transmitted. The module is communicating over the network. No action is required. |

**OK Status Indicator**

| Indicator Condition | Status | Description |
|---|---|---|
| Off | | The module does not have 5V DC power.<br><br>Follow the corrective action below. |
| Flashing Green | BOOTP - XX:XX:XX:XX:XX:XX or xx:xx:xx:xx:xx:xx<br><br>DHCP - XX:XX:XX:XX:XX:XX | The module is not configured. Configure the module |
| Green | XXX.XXX.XXX.XXX OK | The module is operating correctly. No action is required. |
| Flashing red | Duplicate IP XX:XX:XX:XX:XX:XX | A device with the Ethernet MAC address of xx:xx:xx:xx:xx:xx is using the IP address of this module.<br><br>Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |
| | Flash Update | A firmware update is in progress. No action is required. |
| Flashing Red and Green | Rev %d.%d.%d | The module is performing a self test while it is being started. No action is required. |

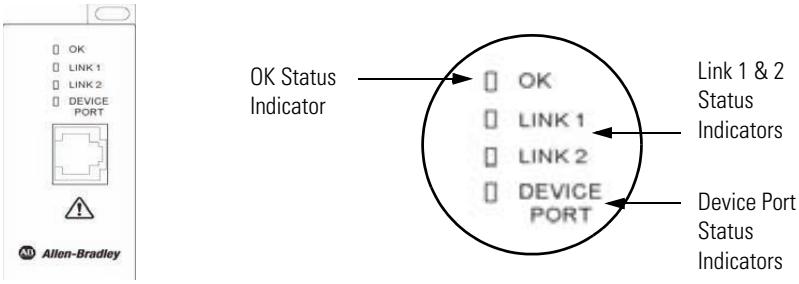
If the **OK status indicator is off**, take the following actions.

1. Verify there is power.
2. Verify that the module is properly installed.

# 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP Tap Status Indicators

The 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP taps have several status indicators.

### 1783-ETAP EtherNet/IP Tap Status Indicators




### OK Status Indicator

| Indicator | Status | Description |
|---|---|---|
| OK | Off | Tap is not powered |
| | Flashing green | Tap is not configured |
| | Solid green | Tap is powered, configured, and operating correctly |
| | Flashing red | One of the following:<br>• Recoverable fault detected, such as duplicate IP address<br>• Flash update in progress is detected |
| | Solid red | Unrecoverable fault detected |

### LINK 1, 2, DEVICE Status Indicator

| Indicator | Status | Description |
|---|---|---|
| LINK 1, 2, DEVICE | Off | One of the following conditions exists:<br>• No link<br>• Port administratively disabled<br>• Port disabled because of rapid-ring fault condition, and this tap is the active ring supervisor (LINK 2)<br>• Ring network has encountered a rare, partial network fault, and this tap is the active supervisor (LINK 2) |
| | Solid green | One of these conditions exists:<br>• A 100 Mbps (full or half duplex) link exists[1] and there is no activity.<br>• Ring network is operating normally, and this tap is the active supervisor (LINK 2) |
| | Flashing green | A 100 Mbps link exists and there is activity |
| | Solid yellow | One of the following conditions exists:<br>• A 10 Mbps (full or half duplex) link exists and there is no activity.<br>• Ring network is operating normally, and this tap is the active supervisor (LINK 2) |
| | Flashing yellow | A 10 Mbps link exists and there is activity |

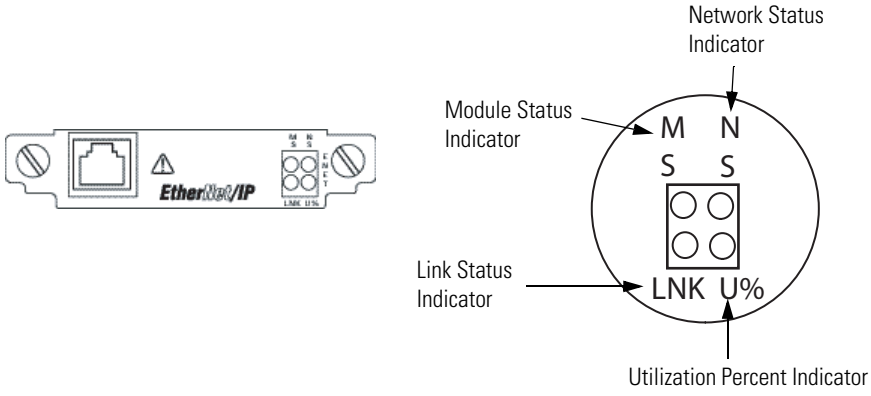
(1) All fiber-optic interfaces will be 100 Mbps, full duplex.

# 1788-ENBT EtherNet/IP Daughtercard Status Indicators

The 1788-ENBT EtherNet/IP communication daughtercard has several status indicators.

**IMPORTANT** The 1788-ENBT card does not display any scrolling messages.

**1788-ENBT EtherNet/IP Daughtercard Status Indicators**




**Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| MS | Off | The daughtercard has no power.<br><br>Follow the corrective action below. |
| | Flashing green | The daughtercard does not have an IP address and is operating in BOOTP mode. Verify that the BOOTP server is running. |
| | Green | The daughtercard is operating correctly. No action required. |
| | Red | The host is holding the daughtercard in reset or the host is faulted.<br><br>Follow the corrective action below. |
| | | The daughtercard is performing a self test while it is being started. No action is required. |
| | | An unrecoverable fault has occurred.<br><br>Follow the corrective action below. |
| | Flashing red | A duplicate IP address has been detected. Make sure that the the IP address assigned to this module is not identical to that of any other device already on the network. |
| | | The daughtercard firmware is being updated. No action is required. |

### Status Indicator

| Indicator | Status | Description |
|---|---|---|
| NS | Off | The daughtercard does not have an IP address and is operating in BOOTP mode. Verify that the BOOTP server is running. |
| | Flashing green | The daughtercard has an IP address, but no CIP connections are established. Follow the corrective action below. |
| | Green | The daughtercard has an IP address and CIP connections (Class 1 or Class 3) are established. No action is required. |
| | Red | A duplicate IP address has been detected. Make sure that the IP address assigned to this module is not the same as that for any other device already on the network. |
| LNK | Off | The daughtercard is not connected to a powered Ethernet module. The daughtercard cannot communicate on an Ethernet network.<br><br>Follow the corrective action below. |
| | Flashing green | The daughtercard is performing a self test while it is being started. No action is required. |
| | | The daughtercard is communicating on an Ethernet network. No action is required. |
| | Green | The daughtercard is connected to a powered Ethernet module. The daughtercard can communicate on an Ethernet network. No action is required. |
| U% | Off | The I/O packet rate to/from this daughtercard is less than 80% of the available packet rate, and less than 80% of the 32 available I/O connections are currently in use. No action is required. |
| | Flashing green | The I/O packet rate to/from this daughtercard is at least 80% of the available packet rate (4000 packets/s). That is, the I/O packet rate is at least 3200 packets/s. No action is required. |
| | | At least 80% of the 32 available connections are currently in use. That is, from 26 to 31 I/O connections are in use. No action is required. |
| | Green | All 32 of the daughtercard's I/O connections are currently in use. No action is required. |
| | Flashing red/green | The daughtercard is performing a self test while it is being started. No action is required. |

If the **MS indicator is off**, take the following actions.

1. Check the host power supply.
2. Verify that the daughtercard is firmly seated in the host's slot.
3. Replace daughtercard or host.

If the **MS indicator is red and the host is holding the daughtercard in reset or the host is faulted**, take the following actions.

1. Verify that the daughtercard is firmly seated in the host's slot.
2. Clear the host's fault.
3. Replace daughtercard or host.

If the **MS indicator is red and an unrecoverable fault has occurred**, take the following actions.

1. Cycle power to the host.
2. Replace the daughtercard or host.

If the **NS status indicator is flashing green**, take the following actions.

1. If no connections are configured, this is normal operation.

   No action is required.
2. If connections are configured, check connection originator for connection error code.

If the **LNK status indicator is off**, take the following actions.

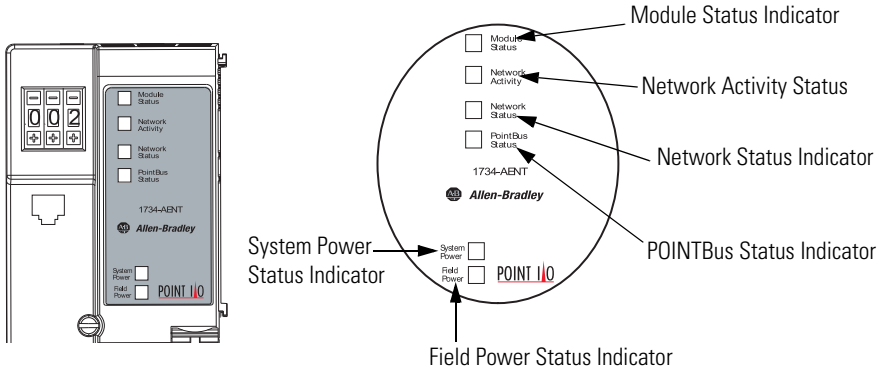
1. Verify that all Ethernet cables are connected.
2. Verify that the Ethernet switch is powered.

# 1734-AENT and 1734-AENTR EtherNet/IP POINT I/O Adapter Status Indicators

The 1734-AENT and 1734-AENTR EtherNet/IP POINT I/O adapters have several status indicators.

**IMPORTANT** The 1734-AENT and 1734-AENTR adapters do not display any scrolling messages.

**1734-AENT EtherNet/IP POINT I/O Adapter Status Indicators**




**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| Module Status | Off | No power is being applied to device. Apply power to the device. |
| | Flashing Red/Green | Status indicator cycle power test (module self-test) is being conducted. No action is required. |
| | Solid Green | The device is operating normally. No action is required. |
| | Flashing Red | Firmware (NVS) is being updated or the address switches have changed.<br><br>Follow the corrective action below. |
| | Solid Red | Self-test failure is present (checksum failure, or ramtest failure at cycle power); firmware fatal error is present. Replace the adapter. |
| Network Activity Status | Off | No link exists. Verify network cabling, and correct, if necessary. |
| | Flashing Green/Off | I/O is being transmitted or received. No action is required. |
| | Steady Green | A link exists. No action is required. |

**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| Network Status | Off | The module has no IP address.<br><br>Follow the corrective action below. |
| | Flashing Green | The module has an IP address, but no CIP connections. No action is required. |
| | Solid Green | The module is online and has an IP address and CIP connections. No action is required. |
| | Flashing Red | One or more CIP connections have timed out. Check for I/O module failure and controller operation, and correct, if necessary. |
| | Solid Red | A duplicate IP address has been detected. Verify IP address setting and correct, if necessary. |
| | Flashing Red/Green | The module is performing a normal self-test, which only occurs during the cycle-power test. No action is required. |
| POINTBus Status | Off | Power has not been applied to the device.<br><br>Follow the corrective action below. |
| | Flashing Red/Green | Status indicator cycle-power test is being performed. No action is required. |
| | Flashing Red | • When power is cycled, the number of expected modules does not equal the number of modules present.<br>• A module is missing.<br>• A node fault (I/O connection timeout) occurred.<br>Follow the corrective action below. |
| | Solid Red | The adapter is bus off. Follow the corrective action below. |
| | Flashing Green | A firmware (NVS) update is in progress. No action is required. |
| | Solid Green | An adapter is online with connections established. No action is required. |
| System Power Status | Off | Field power is off or a DC-DC converter problem exists.<br><br>Follow the corrective action below. |
| | Green | DC-DC converter is active (5V). No action is required. |
| Field Power Status | Off | Field power is off. Apply field power. |
| | Green | 24V power is present. No action is required. |

If the **Module status indicator is flashing red**, take the following actions.

1. Complete firmware update.
2. Verify address switches.

If the **Network status indicator is off**, take the following actions.

1. Apply power to device.
2. Verify, and correct, IP address, if necessary.

If the **POINTBus status indicator is off**, take the following actions.

1. Apply power to device
2. Check module status indicator.

If the **POINTBus status indicator is flashing red**, take the following actions.

1. Configure the chassis size.
2. Check for missing module and reinstall, if necessary.
3. Check for I/O module failure and correct, if necessary.

If the **POINTBus status indicator is solid red**, take the following actions.

1. Cycle power to device.
2. If condition persists, replace device.

If the **System Power status indicator is off**, take the following actions.

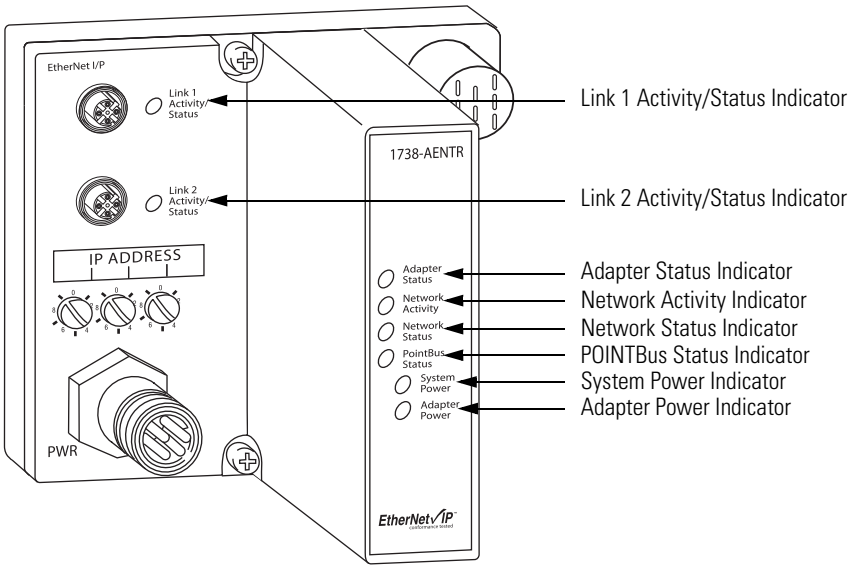
1. Verify that power is on, and apply power if needed.
2. Verify backplane power has not been exceeded, and correct.
3. Replace 1734-AENT module.

# 1738-AENTR ArmorPOINT I/O 2-port EtherNet/IP Adapter Status Indicators

The 1738-AENTR ArmorPOINT I/O 2-port EtherNet/IP adapter has several status indicators.

**IMPORTANT** The 1738-AENTR adapter does not display scrolling messages.

**1738-AENTR ArmorPOINT I/O 2-port EtherNet/IP Adapter Status Indicators**




**Link 1 or Link 2 Activity/Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| Link 1 or Link 2 Activity /Status | Off | No link established. Verify network cabling and correct, if necessary. |
| | Green | Link established at 100 Mbps. No action is required. |
| | Flashing green | Transmit or receive activity present at 100 Mbps. No action is required. |
| | Yellow | Link established at 10 Mbps. No action is required. |
| | Flashing yellow | Transmit or receive activity present at 10 Mbps. No action is required. |

### Adapter Status Indicator

| Indicator | Status | Description |
|---|---|---|
| Adapter Status | Off | No power applied to the adapter. Apply power to the adapter. |
| | Green | Adapter is operating properly. No action required. |
| | Flashing red/green | The adapter is in self-test mode. No action required. |
| | Flashing red | A recoverable fault has been detected due to the one of the following conditions:<br>• A firmware (NVS) update is in process. Allow the process to complete.<br>• The address switches have been changed. Verify the address switches are correct. |
| | Red | An unrecoverable fault has been detected due to one of the following conditions:<br>• A self-test failure<br>• A firmware fatal error<br>In both cases, you must replace the adapter. |

### Network Activity Status Indicator

| Indicator | Status | Description |
|---|---|---|
| Network Activity | Off | No link established with Port 1 or Port 2. Verify network cabling and, if necessary, correct. |
| | Green | One of the following conditions has been detected:<br>• Link established with Port 1 and/or Port 2 at 100 Mbps<br>• Link established with Port 1 and Port 2. One link is at 100 Mbps and one at 10 Mbps.<br>In either case, no action is required. |
| | Flashing green | One of the following conditions has been detected:<br>• Transmit or receive activity present on Port 1 and/or Port 2 at 100 Mbps.<br>• Transmit or receive activity present on Port 1 and/or Port 2. One port at 100 Mbps and one port at 10 Mbps.<br>In either case, no action is required. |
| | Yellow | Link established with Port 1 and/or Port 2 at 10 Mbps. No action is required. |
| | Flashing yellow | Transmit or receive activity present on Port 1 and/or Port at 10 Mbps. No action is required. |

**Network Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| Network Status | Off | Adapter is not initialized and does not have an IP address. Apply power to the device, verify the IP address and set/correct, if necessary. |
| | Green | Adapter is online, has an IP address, and CIP connections are established. No action is required. |
| | Flashing green | Adapter has an IP address, but no CIP connections are established. Establish CIP connections, if necessary. Otherwise, no action is required. |
| | Flashing red/green | Adapter is in self-test. No action is required. |
| | Flashing red | One or more CIP connections has timed out. Check for I/O module failure and controller operation and correct if necessary. |
| | Red | Duplicate IP address is detected. Verify the IP address setting and correct as needed. |

**POINTBus Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| POINTBus Status | Off | Adapter is not online due to one of the following conditions:<br>• Adapter is not powered. Check the Adapter Status indicator.<br>• Adapter has not completed dup_MAC_id test. Apply power to the device, wait for dup_MAC_id to complete and correct, if necessary. |
| | Green | Adapter is online and has connections established. No action is required. |
| | Flashing green | Adapter is online but has not connection established. A firmware (NVS) update is in progress. Wait for the firmware update to complete. |
| | Flashing red/green | Status indicator cycle power test present. No action is required. |
| | Flashing red | One of the following conditions has been detected:<br>• Adapter has detected a network access error and is in communication faulted state.<br>• Adapter has received and accepted an Identify Communication Faulted Request.<br>In either case, verify that the adapter is properly installed and reinstall, if necessary. |
| | Red | An unrecoverable fault has occurred. Follow the corrective action below. |

If the **POINTBus status indicator is red**, take the following actions.

1. Make sure an I/O module is not using a MAC ID = 0.
2. Make sure all backplane modules are communicating at the proper baud rate.
3. Cycle power to the device.
4. If the condition persists, replace the adapter.

**System Power Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| System Power | Off | Adapter power is off or DC-DC converter problem is present. Follow the corrective action below. |
| | Green | System power is on; DC-DC converter output is active (5V). No action is required. |

If the **System Power status indicator is off**, take the following actions.

1. Verify power is on.
2. Apply power, if necessary.
3. Verify backplane power is not exceeded and correct, if necessary.
4. Replace the device.

**Adapter Power Status Indicator**

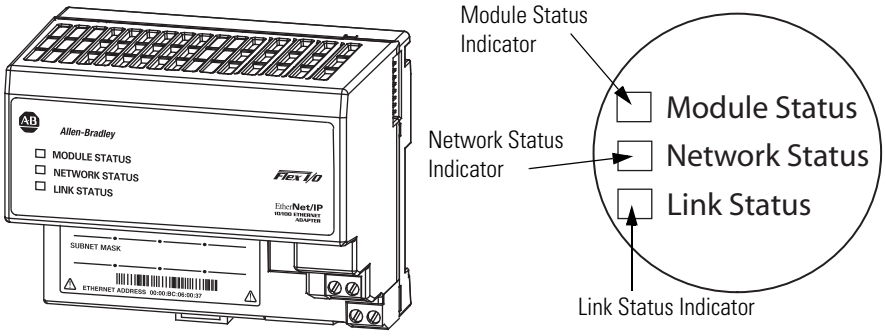
| Indicator | Status | Description |
|---|---|---|
| Adapter Power | Off | Adapter is not active because power is off. Apply adapter power. |
| | Green | 24V DC input power is present. No action is required. |

# 1794-AENT EtherNet/IP FLEX I/O Adapter Status Indicators

The 1794-AENT EtherNet/IP FLEX I/O adapter has several status indicators.

**IMPORTANT** The 1794-AENT adapter does not display any scrolling messages.

**1794-AENT EtherNet/IP Flex I/O Adapter Status Indicators**




**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| Module Status | Off | The module does not have 24V DC power. Make sure power is being supplied to the module. |
| | Flashing green | The module is not configured. Configure the module. |
| | Green | The module is operating correctly. No action is required. |
| | Flashing red | A recoverable fault has been detected. Verify that the module is configured correctly. |
| | Red | An unrecoverable fault has been detected.<br><br>Follow the corrective action below. |
| | Flashing red/green | The module is performing a self test while the module is being started. No action is required. |

**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| Network Status | Off | Power has not been applied to the module, or the module does not have an IP address.<br><br>Follow the corrective action below. |
| | Flashing green | The module has obtained an IP address, but has no established connections.<br><br>If no connections are configured, this is normal operation. No action is required.<br><br>If connections are configured, check connection originator for connection error code. |
| | Green | The module has an IP address and at least one established connection. No action is required. |
| | Flashing red | One or more of the connections in which the module is the target has timed out. Reestablish the connection. |
| | Flashing red/green | The module is performing a self test while it is being started. No action is required. |
| | Red | Adapter has detected that its IP address is already in use. Configure the adapter with a unique IP address. |
| Link Status | Off | No data is being transmitted. No action is required. |
| | Flashing green | The module is ready to communicate. No action is required. |
| | Green | Data is being transmitted. No action is required. |

If the **Module status indicator is red**, take the following actions.

1. Recycle power to the module.
2. If this does not clear the fault, replace the module.

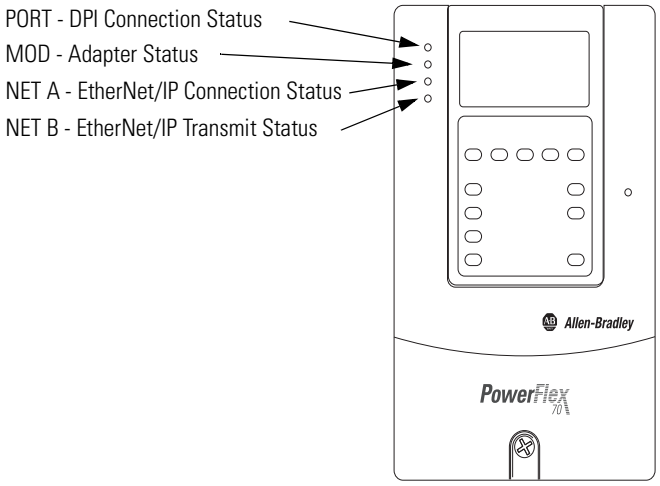
If the **Network status indicator is off**, take the following actions.

1. Verify there is power.
2. Verify that the module is correctly wired to the power supply.
3. Make sure the module is configured.

# 20-COMM-E Module Status Indicators

The 20-COMM-E module has four status indicators.

**20-COMM-E Status Indicators**




**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| PORT | Off | The adapter is not powered or is not properly connected to the drive.<br><br>Follow the corrective action below. |
| | Flashing red | The adapter is not receiving a ping message from the drive.<br><br>Follow the corrective action below. |
| | Solid Red | The drive has refused an I/O connection from the adapter. Another DPI peripheral is using the same DPI port as the adapter.<br><br>Another DPI peripheral is using the same DPI port as the adapter.<br><br>Follow the corrective action below. |
| | Orange | The adapter is connected to a product that does not support Allen-Bradley DPI communication.<br><br>Connect the adapter to a product that supports Allen-Bradley DPI communication (for example, a PowerFlex 7-Class drive). |
| | Flashing Green | The adapter is establishing an I/O connection to the drive. No action is required. |
| | Solid Green | The adapter is properly connected and is communicating with the drive. No action is required. |

**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| MOD | Off | The adapter is not powered or is not properly connected to the drive. Securely connect the adapter to the drive using the Internal Interface (ribbon) cable. Apply power to the drive (or adapter if mounted in a DPI External Comms Kit). |
| | Flashing Red | The adapter has failed the firmware test or the adapter is being flash upgraded. Follow the corrective action below. |
| | Solid Red | The adapter has failed the hardware test. Follow the corrective action below. |
| | Flashing Green | The adapter is operational, but is not transferring I/O data. Follow the corrective action below. |
| | Solid Green | The adapter is operational and transferring I/O data. No action is required. |
| NET A | Off | One of the following:<br>• The adapter and/or network is not powered. In this case, securely connect the adapter to the drive using the Internal Interface (ribbon) cable and to the network using an Ethernet cable.<br>• The adapter is not properly connected to the network. In this case, correctly connect the Ethernet cable to the Ethernet connector.<br>• The adapter needs an IP address. In this case, set a unique IP address using a BOOTP server or by disabling BOOTP and using adapter parameters. Additionally, make sure you have properly applied power to the drive (or adapter, if mounted in a DPI External Comms kit) and the network. |
| | Solid Red | The adapter failed the duplicate IP address detection test. Configure the adapter to use a unique IP address and cycle power. |
| | Flashing Red | An EtherNet/IP connection has timed out. Follow the corrective action below. |
| | Flashing Red/Green | The adapter is performing a self-test. No action is required. |
| | Flashing Green | The adapter is properly connected but is not communicating with any devices on the network. Follow the corrective action below. |
| | Solid Green | The adapter is properly connected and communicating on the network. No action is required. |
| NET B | Off | The adapter is not powered or is nottransmitting on the network. If the adapter is not idle, follow the corrective action below. |
| | Flashing Green | The adapter is transmitting on the network. No action is required. |

If the **PORT status indicator is off**, take the following actions.

1. Securely connect the adapter to the drive using the Internal Interface (ribbon) cable.
2. Apply power to the drive (or adapter if mounted in a DPI External Comms Kit).

If the **PORT status indicator is flashing red**, take the following actions.

1. Verify that cables are securely connected and not damaged; replace cables if necessary.
2. Cycle power to the drive (or adapter, if mounted in a DPI External Comms kit).

If the **PORT status indicator is solid red**, take any of the following actions.

**IMPORTANT** Cycle power to the drive (or adapter if mounted in a DPI External Comms Kit) after making any of the following corrections.

- Verify that all DPI cables on the drive are securely connected and not damaged. Replace cables if necessary.
- Verify that the DPI drive supports Datalinks.
- Configure the adapter to use a Datalink that is not already being used by another peripheral.

If the **MOD status indicator is flashing red**, take the following actions.

1. Clear faults in the adapter.
2. Cycle power to the drive (or adapter if mounted in a DPI External Comms Kit).

   If cycling power does not correct the problem, the adapter parameter settings may have been corrupted.
3. Reset defaults and reconfigure the adapter.
4. If resetting defaults does not correct the problem, flash the adapter with the latest firmware release.

If the **MOD status indicator is solid red**, take the following actions.

1. Cycle power to the drive (or adapter if mounted in a DPI External Comms Kit).
2. Replace the adapter.

If the **MOD status indicator is flashing green**, take the following actions.

1. Place the scanner in RUN mode.

2. Program the controller to recognize and transmit I/O to the adapter.

3. Configure the adapter for the program in the controller.

4. Normal behavior if no DPI I/O is enabled.

If the **NET A status indicator is flashing red**, take the following actions.

1. Place the scanner in RUN mode, or apply power to the peer device that will send I/O.

2. Check the amount of traffic on the network.

If the **NET A status indicator is flashing green**, take the following actions.

1. Place the controller in RUN mode, or apply power to the peer device that will send I/O.

2. Program the controller or peer device to recognize and transmit I/O or make a messaging connection to the adapter.

3. Configure the adapter for the program in the controller or the I/O from the peer device.

If the **NET B status indicator is off and the NET A indicator is off**, take the following actions.

1. Securely connect the adapter to the drive using the Internal Interface (ribbon) cable and to the network using an Ethernet cable.

2. Correctly connect the Ethernet cable to the Ethernet connector.

3. Set a unique IP address using a BOOTP server or by disabling BOOTP and using adapter parameters.

If the **NET B status indicator is off and the NET A indicator is solid red**, configure the adapter to use a unique IP address and cycle power.

If the **NET B status indicator is off and the NET A indicator is flashing red/green or solid red**, take the following actions.

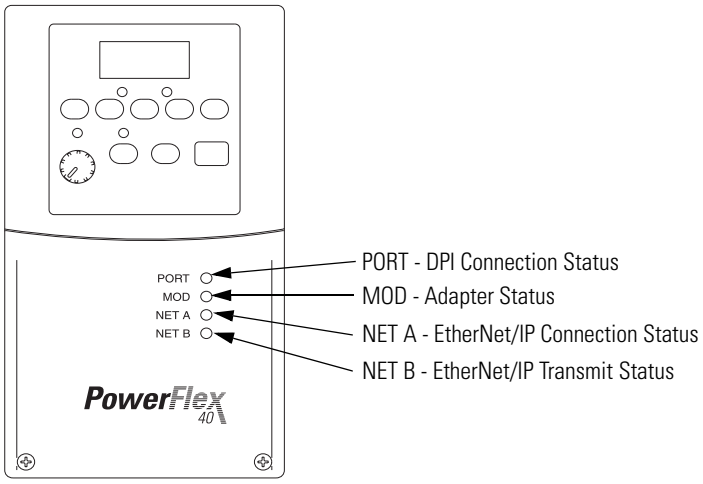
1. Check the IP address in the adapter and scanner, and verify that the controller can communicate with the adapter.

2. Ping the adapter.

# 22-COMM-E Module Status Indicators

The 22-COMM-E module has four status indicators.

**22-COMM-E Status Indicators**




**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| PORT | Off | The adapter is not powered or is not properly connected to the drive.<br><br>Follow the corrective action below. |
| | Flashing Red | In Single mode, the adapter is not receiving communication from the drive.<br><br>In Multi-Drive mode, the adapter is not receiving communication from a drive, or a drive is not an Allen-Bradley drive.<br><br>Follow the corrective action below. |
| | Flashing Green | The adapter is establishing communication with the drive. No action required. This status indicator will turn solid green or flashing red. |
| | Solid Green | The adapter is properly connected and is communicating with the drive. No action required. |
| | Orange | In Single mode, the drive is not an Allen-Bradley drive. Use an Allen-Bradley PowerFlex 40 drive. |
| MOD | Off | The adapter is not powered or is not properly connected to the drive. Follow the corrective action below. |
| | Flashing Red | The adapter has failed the firmware test. Follow the corrective action below. |
| | Solid Red | The adapter has failed the hardware test. Follow the corrective action below. |
| | Flashing Green | The adapter is operational, but is not transferring I/O data. Follow the corrective action below. |
| | Solid Green | The adapter is operational and transferring I/O data. Follow the corrective action below. No action is required. |

**Module Status Indicator**

| Indicator | Status | Description |
|---|---|---|
| NET A | Off | One of the following:<br>• The adapter and/or network is not powered.<br>• The adapter is not properly connected to the network.<br>• The adapter needs an IP address.<br>Follow the corrective action below. |
| | Solid Red | The adapter failed the duplicate IP address detection test. Configure the adapter to use a unique IP address and cycle power. |
| | Flashing Red | An EtherNet/IP connection has timed out. Follow the corrective action below. |
| | Flashing Green | The adapter is properly connected but is not communicating with any devices on the network. |
| | Solid Green | The adapter is properly connected and communicating on the network. No action is required. |
| NET B | Off | If the adapter is idle, normal condition. No action is required.<br>If the adapter is not idle, then the adapter is not powered or is not transmitting on the network. In this case, follow the corrective action below. |
| | Flashing Green | The adapter is transmitting on the network. No action is required. |

If the **PORT status indicator is off**, take the following actions.

1. Securely connect the adapter to the drive using the Internal Interface (ribbon) cable.
2. Apply power to the drive.

If the **PORT status indicator is flashing red**, take the following actions.

1. Verify the setting for Parameter 22 - [DSI I/O Cfg].
2. Verify that cables are securely connected and not damaged; replace cables if necessary.
3. Cycle power to the drive.
4. Use Allen-Bradley PowerFlex 4/40 drives.

If the **MOD status indicator is off**, take the following actions.

1. Securely connect the adapter to the drive using the Internal Interface (ribbon) cable.
2. Apply power to the drive.

If the **MOD status indicator is flashing red**, take the following actions.

1. Cycle power to the drive.
2. If cycling power does not correct the problem, the adapter parameter settings may have been corrupted. Reset defaults and reconfigure the adapter.
3. If resetting defaults does not correct the problem, flash the adapter with the latest firmware release.

If the **MOD status indicator is solid red**, take the following actions.

1. Cycle power to the drive.
2. Replace the adapter.

If the **MOD status indicator is flashing green**, take the following actions.

1. Place the scanner in RUN mode.
2. Program the controller to recognize and transmit I/O to the adapter.
3. Configure the adapter for the program in the controller.
4. Normal behavior if no DPI I/O is enabled.

If the **NET A status indicator is off**, take the following actions.

1. Securely connect the adapter to the drive using the Internal Interface (ribbon) cable and to the network using an Ethernet cable.
2. Correctly connect the Ethernet cable to the Ethernet connector.
3. Set a unique IP address using a BOOTP server or by disabling BOOTP and using adapter parameters.
4. Apply power to the drive (or adapter, if mounted in a DPI External Comms kit) and network.

If the **NET A status indicator is flashing red**, take the following actions.

1. Place the scanner in RUN mode.
2. Check the amount of traffic on the network.

If the NET A status indicator is flashing green, take the following actions.

1. Place the controller in RUN mode.

2. Program the controller or peer device to recognize and transmit I/O or make a messaging connection to the adapter.

3. Configure the adapter for the program in the controller or the I/O from the peer device.

If the **NET B status indicator is off and the NET A indicator is off**, take the following actions.

1. Securely connect the adapter to the drive using the Internal Interface (ribbon) cable and to the network using an Ethernet cable.

2. Correctly connect the Ethernet cable to the Ethernet connector.

3. Set a unique IP address using a BOOTP server or by disabling BOOTP and using adapter parameters.

If the **NET B status indicator is off and the NET A indicator is solid red**, take the following actions.

1. Configure the adapter to use a unique IP address.

2. Cycle power to the adapter.

If the **NET B status indicator is off and the NET A indicator is flashing red/green or red**, take the following actions.

1. Check the IP address in the adapter and scanner, and verify that the controller can communicate with the adapter.

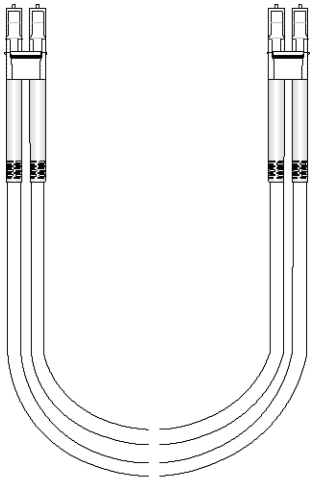
2. Ping the adapter.

# Fiber Cable and LC Connector

## Introduction

This appendix provides specifications for the fiber cable and LC connector used with the 1756-EN2F EtherNet/IP fiber module or the 1783-ETAP1F and 1783-ETAP2F EtherNet/IP fiber taps.

**Fiber Cable**



## Specifications

The 1756-EN2F EtherNet/IP fiber module and the 1783-ETAP1F and 1783-ETAP2F EtherNet/IP fiber taps use a fiber cable and LC connector. The fiber cable is typically used in 1 m (3 ft), 2 m, (6 ft), 3 m (9 ft), 5 m (15 ft), and 100 m (300 ft) lengths but supports lengths up to 2 km (1.24 mi) ..

**IMPORTANT** You can special order a fiber cable in any length up to 2 km (1.24 mi) from your fiber cable vendor.

The fiber cable and LC connector support the following specifications.

| Attribute | Value |
|---|---|
| Fiber Transceiver Type | 100Base-FX IEEE802.3u |
| Optical Wavelength | 1310 nm no cap |
| Transmitter Launch Power at Beginning of Life (BOL), min<br><br>Allow -1 dB at End of Life (EOL) | -19 dBm into 62.5/125 µm fiber, N/A = 0.275<br><br>-22.5 dBm into 50/125 µm fiber, N/A = 0.20 |
| Receiver Sensitivity, Min | -31.8 dBm |

| Attribute | Value |
|---|---|
| Receiver Sensitivity, Max | -14 dBm |
| Fiber Channel Power Budget at Rated BER (Two connected modules or taps, either the 1756-EN2F EtherNet/IP fiber module, or 1783-ETAP1F or 1783-ETAP2F EtherNet/IP fiber taps) | 12.8 dB for 62.5/125 µm multimode fiber<br><br>9.3 dB for 50/125 µm multimode fiber |
| Fiber Type | Glass<br><br>62.5/125 µm and 50/125 µm multimode fiber<br><br>Simplex or duplex<br><br>Jacket type and jacket diameter is dependent on connector selection<br><br>Graded Index (GI) fiber<br><br>Per IEC 60794-1-1, IEC 60793-2-10 category A1 fibers |
| Connector Type | IEC 61754-20 LC connector, maximum insertion loss 0.75 dB per connection |
| Channel Length, Max | 2 km (1.24 mi) (1) |

(1) The channel, that is, connectors and cable, must not exceed the allowable power budget.

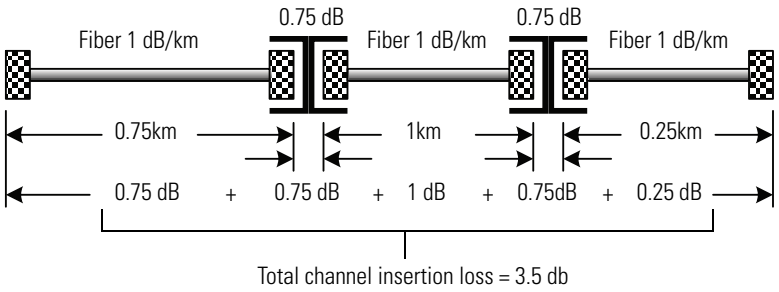
**IMPORTANT** You should allow at least 5.08 cm (2 in.) for the fiber cable bend radius. Contact the cable manufacturer for more information on recommended cable bend radius.

**EXAMPLE**

In the example shown here, the channel insertion loss is calculated for an optical channel based on the following factors:

- 1 dB/km fiber
- 0.75 dB per adapter

Note that in this example, the end connectors are not factored in the calculations.




The maximum power budget for this example is 12.8 dB for 62.5/125 um fiber. Therefore, the channel insertion loss for the example of 3.5 dB is less than the maximum power budget.

## Notes:

# EtherNet/IP Network Connections

## Introduction

EtherNet/IP communication modules use connections to manage communication. A connection is a point-to-point communication mechanism used to transfer data between a transmitter and a receiver. The EtherNet/IP communication modules use these connections:

- CIP connections for Logix-based communication.

  A CIP connection transfers data from one Logix application running on one end node to a second Logix application running on another end node. A CIP connection is established over a TCP connection.

- TCP/IP connections for EtherNet/IP communication.

  A single TCP connection can support multiple CIP connections.


| Topic | Page |
|---|---|
| CIP Connections | 213 |
| TCP Connections | 214 |
| Multicast Address Limit | 215 |


## CIP Connections

Connected modules communicate more reliably than do unconnected modules.

Examples of functions supported by CIP implicit (connected) messaging include:

- Logix controller message transfer to Logix controller.
- I/O or produced/consumed tag.
- program upload.
- RSLinx DDE/OPC client.
- PanelView polling of Logix controller.

**Types of CIP Connections**

| CIP Connection Type | Description |
|---|---|
| Bridged | A bridged connection is a connection that passes through the EtherNet/IP module. The end point of the connection is a module other than the EtherNet/IP module.<br><br>**Example:** a connection from a controller through a 1756-ENBT module to another controller. |
| Rack-optimized | A rack-optimized connection is a connection to a rack or assembly object in the EtherNet/IP module. Data from selected I/O modules is collected and produced on one connection (the rack-optimized connection) rather than on a separate direct connection for each module. |
| Direct | A direct connection is a connection from a controller to a specific I/O module, as opposed to a rack-optimized connection. |

The Logix5000 controller supports 250 connections, but the limit of connections ultimately resides in the communication module you use for the connection. If a message path routes through a communication module or card, the connection related to the message also counts towards the connection limit of the communication module or card.

## TCP Connections

An EtherNet/IP module uses one TCP connection for each IP address to which the EtherNet/IP module is connected. Multiple CIP connections can go through a single TCP connection. Examples of TCP connections include:

- HMI (human-machine interface) to a controller that supports EtherNet/IP communication.
- Logix MSG instruction to a controller or workstation.
- OPC or DDE accessing a controller.
- I/O data.
- produced or consumed tags.

The 1756-ENBT, 1788-ENBT, and 1794-AENT modules each support 64 TCP connections.

A TCP connection is established when a controller initiates one. For example, when controller A sends a MSG to controller B, the Ethernet modules associated with controller A and controller B both have a TCP connections. Additionally, if controller B initiates a MSG to controller A, both Ethernet modules now have 2 TCP connections in use. For any further commuinications, such as MSG exchanges, producing tags, or I/O communication, bridging between Ethernet module associated with controllers A and B modules, no more TCP connections are required.

## Multicast Address Limit

Connections that produce data over an Ethernet network use multicast addresses. EtherNet/IP modules support a maximum of 32 unique multicast addresses. The actual address, such as 239.192.22.121, is determined by the EtherNet/IP module.

**Example 1:** An Ethernet adapter that produces data uses a unique multicast address for each I/O connection.

**Example 2:** A Logix controller that produces tags uses a unique multicast address for each produced tag.

The multicast address limit is independent of the connection limit for a module. Not all connections require a multicast address. And for produced and consumed tags, one produced tag requires one multicast address and one connection for each consumer. For multiple consumers, the one multicast address would use multiple connections.

## Requested Packet Interval (RPI)

The RPI is the update rate specified for a particular piece of data on the network. The RPI can be specified for an entire rack (using a rack-optimized connection) or for a particular module (using a direct connection).

When adding a module to the I/O configuration of a controller, you must configure the RPI. This value specifies how often to produce the data for that module. For example, if you specify an RPI of 50 ms, every 50 ms the I/O module sends its data to the controller or that the controller sends its data to the I/O module.

RPIs are used only for implicit connections, such as produced/consumed tags and I/O. For example, a local EtherNet/IP communication module does not require an RPI because it does not produce data for the system but acts only as a bridge to remote modules.

Set the RPI only as fast as needed by the application. The RPI also determines the number of packets per second that the module will produce on a connection.

Each module has a limit on the total number of implicit packets per second. The total includes the sum of sent and received implicit packets. The packet rate for implicit messages is for implicit only, and neither matches nor includes the explicit packet rate.

## Notes:

# EtherNet/IP Network Overview

## Introduction

This appendix defines some basic Ethernet network concepts and how the EtherNet/IP protocol is used for control.


| Topic | Page |
|---|---|
| Ethernet Protocols | 217 |
| Configuration Requirements | 219 |
| Manual Configuration on an Ethernet Switch | 222 |
| Change Ports on an Ethernet Switch | 222 |
| Additional Resources | 222 |


## Ethernet Protocols

On the most basic level, Ethernet is a wire or cable that connects computers and peripheral modules so that they can communicate. The actual wire used for the network is referred to as the network medium. Beyond the physical medium, all Ethernet networks support protocols that provide sophisticated data transfer and network management capability.

**Protocol Descriptions**

| Protocol | Description |
|---|---|
| Transmission control protocol/internet protocol (TCP/IP) | TCP/IP is a transport-layer protocol (TCP) and a network-layer protocol (IP) commonly used in business environments for communication within networks and across internetworks. The EtherNet/IP communication modules use TCP/IP for explicit messaging, that is, messages in which time is not a critical factor, such as uploading or downloading programs. |
| User datagram protocol/Internet protocol (UDP/IP) | UDP is a much simpler transport protocol. It is connectionless and provides a simple means of sending datagrams between two modules. UDP is used by applications that implement their own handshaking between modules and only require minimal transport service. UDP is smaller, simpler, and faster than TCP and can operate in unicast, multicast, or broadcast mode. The EtherNet/IP communication modules use UDP/IP for real time I/O messaging. |
| CIP | CIP applies a common application layer over an Ethernet network by encapsulating messages in TCP/UDP/IP. This common application layer is the control and information protocol (CIP), which provides interoperability and interchangeability of industrial automation and control modules on an Ethernet network. EtherNet/IP supports both real-time I/O (implicit messaging) and explicit messaging.<br><br>See the EtherNet/IP Performance and Application Guide, publication ENET-AP001, for more information on EtherNet/IP. |

**Protocol Descriptions**

| Protocol | Description |
|---|---|
| Simple network management protocol (SNMP) | SNMP is a standard for network management within TCP/IP environments. This protocol enables client applications monitor and manage network information on host computers and gateways. This protocol is password-protected.<br><br>SNMP uses a distributed architecture consisting of management systems and agents. Data is passed from SNMP agents, which are hardware or software processes reporting activity in each network module (switch, router or bridge) to the workstation console used to oversee the network. The agents return information contained in a management information base (MIB), which is a data structure that defines what is obtainable from the module and what can be controlled. |
| Internet Group Management protocol (IGMP) snooping | IGMP snooping enables switches to route multicast traffic by distributing each packet only to the ports that need to receive it. Many switches support this feature. However, for IGMP snooping to work, most of these switches require a system router. If your control system is a stand-alone network or is required to continue performing if the router is out of service, make sure the switch you are using supports IGMP snooping without a router present.<br><br>This feature is highly recommended for EtherNet/IP systems the control I/O. |

## Use of the Common Industrial Protocol (CIP)

The EtherNet/IP communication modules use the Common Industrial Protocol (CIP). CIP is the application layer protocol specified for EtherNet/IP, the Ethernet Industrial Protocol, as well as for ControlNet and DeviceNet.

CIP is a message-based protocol that implements a relative path to send a message from the producing module in a system to the consuming modules.

The producing module contains the path information that steers the message along the proper route to reach its consumers. Since the producing module holds this information, other modules along the path simply pass it along because they do not need to store the information. This information handling has two significant benefits.

- You do not need to configure routing tables in the bridging module, which greatly simplifies maintenance and module replacement.
- You maintain full control over the route taken by each message, which enables you to select alternative paths for the same end module.

CIP uses the producer/consumer networking model instead of a source/destination (master/slave) model. The producer/consumer model reduces network traffic and increases speed of transmission.

In traditional I/O systems, controllers poll input modules to obtain their input status. In the CIP system, digital input modules are not polled by a controller. Instead, they produce (multicast) their data either upon a change of state

(COS) or at a requested packet interval (RPI). The frequency of update depends upon the options chosen during configuration and where on the network the input module resides. The input module, therefore, is a producer of input data and the controller is a consumer of the data.

The controller can also produce data for other controllers to consume. The produced and consumed data is accessible by multiple controllers over the Logix backplane and over the EtherNet/IP network. This data exchange conforms to the producer/consumer model.

## Configuration Requirements

Before you can use an EtherNet/IP module, you must configure its IP address, gateway address, and subnet mask.

### IP Address

The IP address identifies each node on the IP network or system of connected networks. Each TCP/IP node on a network must have a unique IP address.

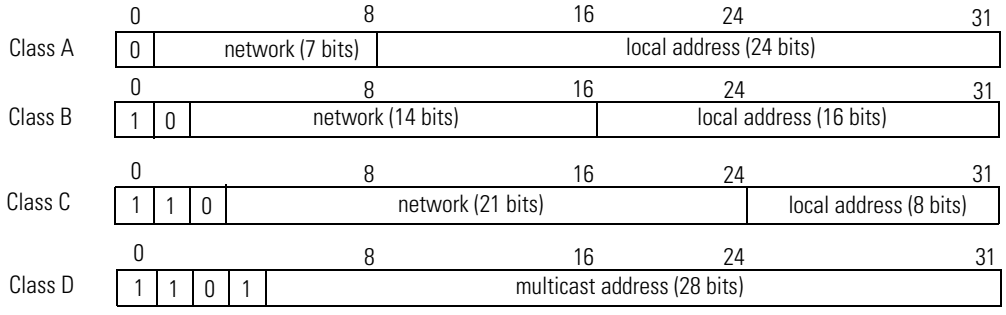
**IMPORTANT** Contact your network administrator or the Network Information Center for a unique fixed IP address to assign to the EtherNet/IP module.

The IP address is 32 bits long and has a network ID part and a host ID part. Because networks vary in size, there are four types of networks.

**EtherNet/IP Network Types**

| Network Type | For |
|---|---|
| Class A | Large networks with many devices |
| Class B | Medium-sized networks |
| Class C | Small networks (fewer than 256 devices) |
| Class D | Multicast addresses |

The network class determines how an IP address is formatted.



Each node on the same physical network must have an IP address of the same class and must have the same network ID. Each node on the same network must have a different local address (host ID), thus giving it a unique IP address.

IP addresses are written as four-decimal integers (0...255) separated by periods where each integer gives the value of one byte of the IP address.

For example, the 32-bit IP address:

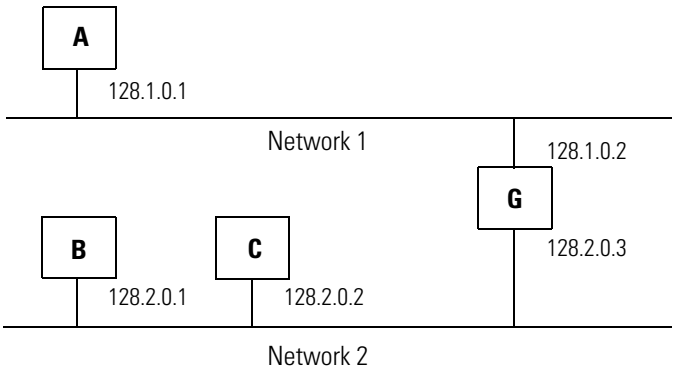
10000010 00000000 00000000 00000001 is written as 130.0.0.1.

**IP Address Class**

| Class | Leftmost Bits | Start Address | Finish Address |
|---|---|---|---|
| A | 0*xxx* | 0.0.0. | 127.255.255.255 |
| B | 10*xx* | 128.0.0.0 | 191.255.255.255 |
| C | 110*x* | 192.0.0.0 | 223.255.255.255 |
| D | 1110 | 224.0.0.0 | 239.255.255.255 |

## Gateways

A gateway connects individual physical networks into a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. The following figure shows gateway G connecting Network 1 with Network 2.




When host B with IP address 128.2.0.1 communicates with host C, it knows from C's IP address that C is on the same network. In an Ethernet environment, B can then resolve C's IP address to a MAC address and communicate with C directly.

When host B communicates with host A, it knows from A's IP address that A is on another network because the network IDs differ. To send data to A, B must have the IP address of the gateway connecting the two networks. In this example, the gateway's IP address on Network 2 is 128.2.0.3.

The gateway has two IP addresses (128.1.0.2 and 128.2.0.3). Network 1 hosts must use the first IP address, and Network 2 hosts must use the second IP address. To be usable, a host's gateway IP address must match its own net ID.

## Subnet Mask

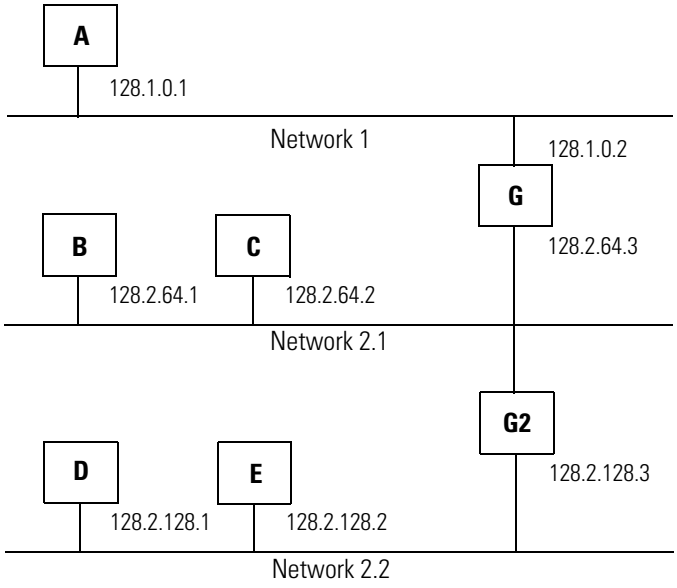
Subnet addressing is an extension of the IP address scheme that enables a site to use a single net ID for multiple physical networks. Routing outside of the site continues by dividing the IP address into a net ID and a host ID via the IP class. Inside a site, the subnet mask is used to redivide the IP address into a custom net ID portion and host ID portion.

Take Network 2 (a Class B network) in the previous example and add another physical network. Selecting this subnet mask would add two additional net ID bits allowing for four physical networks.

11111111 11111111 11000000 00000000 = 255.255.192.0

Two bits of the Class B host ID have been used to extend the net ID. Each unique combination of bits in the part of the host ID where subnet mask bits are 1 specifies a different physical network.

**New Configuration**



A second network with Hosts D and E has been added. Gateway G2 connects Network 2.1 with Network 2.2. Hosts D and E will use Gateway G2 to communicate with hosts not on Network 2.2. Hosts B and C will use Gateway G to communicate with hosts not on Network 2.1. When B is communicating with D, G (the configured Gateway for B) will route the data from B to D...G2.

## Manual Configuration on an Ethernet Switch

The EtherNet/IP modules support these Ethernet settings.

- 10 MBps half-duplex or full-duplex
- 100 MBps half-duplex or full-duplex

Mode selection can be automatic, based on the IEEE 802.3 autonegotiation protocol. Or, with RSLogix 5000 programming software, version 12 and later, you can manually set the communication rate and duplex mode of the communication module and the switch port that is connected to the module. If you manually set the communication rate and duplex mode, the settings of the communication module and the switch port must match.

## Change Ports on an Ethernet Switch

If you reconnect the EtherNet/IP module from one port to another, regardless of whether the new port is on the same or a different switch (or a hub), perform this procedure.

1. Disconnect the cable from the port to which the EtherNet/IP module is currently connected.
2. Wait until the EtherNet/IP module Link Status status indicator is off.
3. Connect the cable to the new port.

This procedure restarts the autonegotiation process at the EtherNet/IP module side. Another option is to restart the EtherNet/IP module itself.

## Additional Resources

For more information about TCP/IP and Ethernet technologies, see these publications.

| Publication Title | ISBN Number |
|---|---|
| Internetworking with TCP/IP Volume 1: Protocols and Architecture, 2nd ed. by Douglas E. Comer | ISBN 0-13-216987-8 |
| The Ethernet Management Guide – Keeping The Link | ISBN 0-07-046320-4 |
| An Introduction to TCP/IP | ISBN 3-540-96651-X |
| Computer Networks by Andrew S. Tanenbaum | ISBN 0-13-162959-X |

## Numerics

**1732E modules** 59
**1734-AENT and 1734-AENTR modules** 58
additional resources 20
overview 20
status indicators 192
**1738-AENT and 1738-AENTR modules** 58
additional resources 21
overview 21
status indicators 195
**1756-EN2F module**
additional resources 16
overview 15
status indicators 171
**1756-EN2T module**
additional resources 16
overview 15
status indicators 173
**1756-EN2TR module**
additional resources 16
overview 15
status indicators 175
use on a device-level ring 58
**1756-EN2TXT module**
additional resources 16
overview 15
status indicators 177
**1756-ENBT module**
additional resources 15
overview 15
status indicators 169
**1768-ENBT module**
additional resources 17
overview 17
status indicators 185
**1769-L23E-QB1B and 1769-L23E-QBFC1B modules**
additional resources 17
overview 17
status indicators 178
**1769-L32E and 1769-L35E modules**
additional resources 18
overview 18
status indicators 183
**1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F taps**
additional resources 19
overview 18
status indicators 187
use on a device-level ring 58
**1788-ENBT module**
additional resources 19
overview 19
status indicators 189
**1794-AENT module**
additional resources 20
overview 20
status indicators 199
**2x-COMM-E modules**
additional resources 22
overview 22
status indicators 201, 205

## A

**access distributed I/O modules** 90-92
**add distributed I/O modules**
overview 78-81
selecting a remote adapter 87
with RSLogix 5000 programming software 91
**additional resources**
1734-AENT and 1734-AENTR modules 20
1738-AENT and 1738-AENTR modules 21
1756-EN2F module 16
1756-EN2T module 16
1756-EN2TR module 16
1756-EN2TXT module 16
1756-ENBT module 15
1756-EWEB and 1768-EWEB modules 32
1768-ENBT module 17
1769-L23E-QB1B and 1769-L23E-QBFC1B modules 17
1769-L32E and 1769-L35E modules 18
1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F taps 19
1788-ENBT module 19
1794-AENT module 20
2x-COMM-E modules 22
Guard I/O modules 26
Stratix switches 39
**add-on profile** 65
**architectures**
safety 26

## B

**beacon interval** 70
**beacon timeout** 70
**BOOTP/DHCP server**
setting IP network address 45-46
**bridging**
with EtherNet/IP modules 27-29

## C

**change ports** 222
**CIP connections** 30, 213
**communication driver** 34-35
**communication format** 82-87
choosing direct or rack-optimized connection 83
direct connections 84
ownership 86-87
rack-optimized connections 85
**configuration parameters**
beacon interval 70
beacon timeout 70
ring protocol VLAN ID 70
**configure**
DHCP software 51
EtherNet/IP modules 41-55
MSG instructions 127
personal computer 33-35
RSLinx communication software 48-49
RSLogix 5000 programming software 50
Stratix switches 37-39
**connections**
caching MSG instructions 106
CIP 30, 213
data transfer 106
I/O 83
interlocking 96
messaging 106
multicast address limits 215
overview 213-215
produced and consumed tags 96
TCP 30, 214
to PanelView terminals 132
to RSView applications 136
troubleshooting 152
**consume tags** 95, 100-104
**control application** 55
**control I/O**
adding distributed I/O modules 78-81
communication format 82-87
connections 83
hardware 77-92
ownership 86
RPI 88
**control system** 23
**controller ownership** 86
**convert between INTs and DINTs** 115

## D

**data transfer**
caching connections 106
configuring 111-114
connections 106
guidelines 105
logic 107-110
mapping tags 116
overview 93-118
to PLC-5 or SLC processors 115
**device-level ring network** 57-75
supervisor node 61-62
**DHCP software** 51
**diagnostics**
Ethernet statistics 144
message connections 142
monitor 137-145
network settings 141
overview 138
**direct connection** 83
**DNS addressing** 54-55
**domain name** 42
**download** 55
**driver** 34-35
**duplicate address detection** 51-53

## E

**email**
MSG instruction 127
overview 119
send through an EtherNet/IP module 119-130
sending via MSG instruction 121-128
status codes 129
text format 129
**Ethernet protocols** 217-219
**EtherNet/IP modules**
bridging 27-29
configuring 41-55
connections 213-215
control application 55
features 13-31
network overview 217-222
network specifications 30
set IP network address 43
setting IP network address 43
status indicators 167-208
using in control system 23

**examples**
accessing distributed I/O modules 91
bridging 29
buffering INTs 117
RSLinx communication software bridging 28

## F

**fiber cable**
specifications 209
**flash upgrade firmware**
USB port 165

## G

**gateway** 42, 220
**Guard I/O modules** 25
in EtherNet/IP system 24

## H

**host name** 42

## I

**I/O**
controlling over EtherNet/IP 77-92
**interlocking**
connections 96
consume tags 100-104
organize tags 95
overview 93-118
produce tags 98-99
terminology 95
**IP addresses**
definition 41
DHCP software 51
duplication address detection 51-53
network address configuration switch settings 44
overview 219
RSLinx communication software 48-49
RSLogix 5000 programming software 50
set 43
swapping in redundant systems 53

## M

**manual configuration** 222
**map tags** 116
**messaging**
caching connections 106
configuring 111-114
connections 106
guidelines 105
logic 107-110
mapping tags 116
overview 93-118
to PLC-5 or SLC processor 115
**MSG instruction**
caching connections 106
configuring 111-114
connections 106
logic 107-110
mapping tags 116
sending email 127
sending via an email 121-128
to PLC-5 or SLC processors 115
**MSG instructions**
guidelines 105

## N

**network address**
DNS addressing 54-55
set IP network address 43
**network overview**
modules in an EtherNet/IP control system 23
**network parameters** 47
DNS addressing 42
domain name 42
gateway 42
host name 42
IP addresses 41
subnet mask 41

## O

**ownership** 86
listen-only connection 86
owner controller 86

## P

**PanelView terminals**
adding in RSLogix 5000 programming software 133-135
communication with Logix controller over EtherNet/IP 131-136
determining connections 132
organizing controller data 136
set up hardware 131

**personal computers**
placing on network 33-35
**PLC-5 processor** 115
**produce tags** 95, 98-99
**produced and consumed tags**
connections 96
consume tags 100-104
number of multicast 31
organize tags 95
overview 93-118
produce tags 98-99
set up hardware 93
terminology 95

## R

**rack-optimized connection** 83
**remote adapter** 87
**requested packet interval** 88-89, 215
**ring protocol VLAN ID** 70
**ring supervisor**
configure with RSLogix 5000 programming software 64
enable in RSLogix 5000 programming software 68
**RPI** 88
**RSLinx communication software**
bridging 28
communication driver 34-35
configuring network parameters 48-49
**RSLogix 5000 programming software**
adding a PanelView terminal 133-135
adding distributed I/O modules 78-81, 91
configure a ring supervisor 64
consume a tag 100-104
enable ring supervisor 68
produce a tag 98-99
set the requested packet interval 88-89
setting IP network address 43
verify supervisor configuration 75

## S

**safety**
additional resources 26
architectures 26
Guard I/O modules in EtherNet/IP system 24
**select a remote adapter** 87
**serial communication**
USB port 161-165
**set IP network address** 43
BOOTP/DHCP server 45-46
RSLinx communication software or RSLogix 5000 programming software 43
thumbwheel switch 43
**set the requested packet interval**
with RSLogix 5000 programming software 88-89
**set up hardware**
data transfer 93
I/O modules over EtherNet/IP 77
interlocking 93
messaging 93
PanelView terminals and Logix controllers 131
produced and consumed tags 93
Stratix switches 38
to share data via a USB port 161
**set up I/O**
controlling I/O 77-92
**set up USB driver** 163
**SLC processor** 115
**specifications**
EtherNet/IP network 30
fiber cable 209
**status codes**
email 129
**status indicators**
1734-AENT and 1734-AENTR modules 192
1738-AENT and 1738-AENTR modules 195
1756-EN2F module 171
1756-EN2T module 173
1756-EN2TR module 175
1756-EN2TXT module 177
1756-ENBT module 169
1768-ENBT module 185
1769-L23E-QB1B and 1769-L23E-QBFC1B modules 178
1769-L32E and 1769-L35E modules
status indicators 183
1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F taps 187
1788-ENBT module 189
1794-AENT module 199
2x-COMM-E modules 201, 205
EtherNet/IP Modules 167-208
**Stratix switches** 37-39
additional resources 39
features 38-39
select a switch 37
set up hardware 38

**string tags** 121
**subnet mask** 41, 221
**supervisor configuration**
verify 75
**supervisor node** 61-62
**swap IP addresses** 53
**switch considerations** 157-159
**switches** 222
IP network address configuration settings 44
select a Stratix switch 37
Stratix switch features 38-39
Stratix switches 37-39

## T

**tags**
produced and consumed 31
**TCP connections** 214
**thumbwheel switch**
set IP network address 43
**troubleshoot**
DLR network 75
Ethernet statistics 153-156
EtherNet/IP modules 147-159
I/O connections 153
message connections 152
switch considerations 157-159
web browser support 147-156
with a virtual local area network 158

## U

**USB port**
configure a module 162-165
flash upgrade firmware 165
serial communication 161-165
set up hardware 161

## W

**web browser support** 147-156

# Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

## Installation Assistance

If you experience an anomoly within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

| | |
|---|---|
| United States or Canada | 1.440.646.3434 |
| Outside United States or Canada | Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative. |

## New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

| | |
|---|---|
| United States | Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process. |
| Outside United States | Please contact your local Rockwell Automation representative for the return procedure. |

# Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

**www.rockwellautomation.com**

**Power, Control and Information Solutions Headquarters**

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication ENET-UM001I-EN-P - January 2010
Supersedes Publication ENET-UM001G-EN-P - September 2009
Copyright © 2010 Rockwell Automation, Inc. All rights reserved. Printed in the U.S.A.